UNIVERSITY OF MICHIGAN
JAN 3 19
ENGINEERING LIBRARY

The Engineer

VOL. CXC—No. 4951 | 28, ESSEX ST., STRAND, LONDON, W.C.2 | DECEMBER 15, 1950

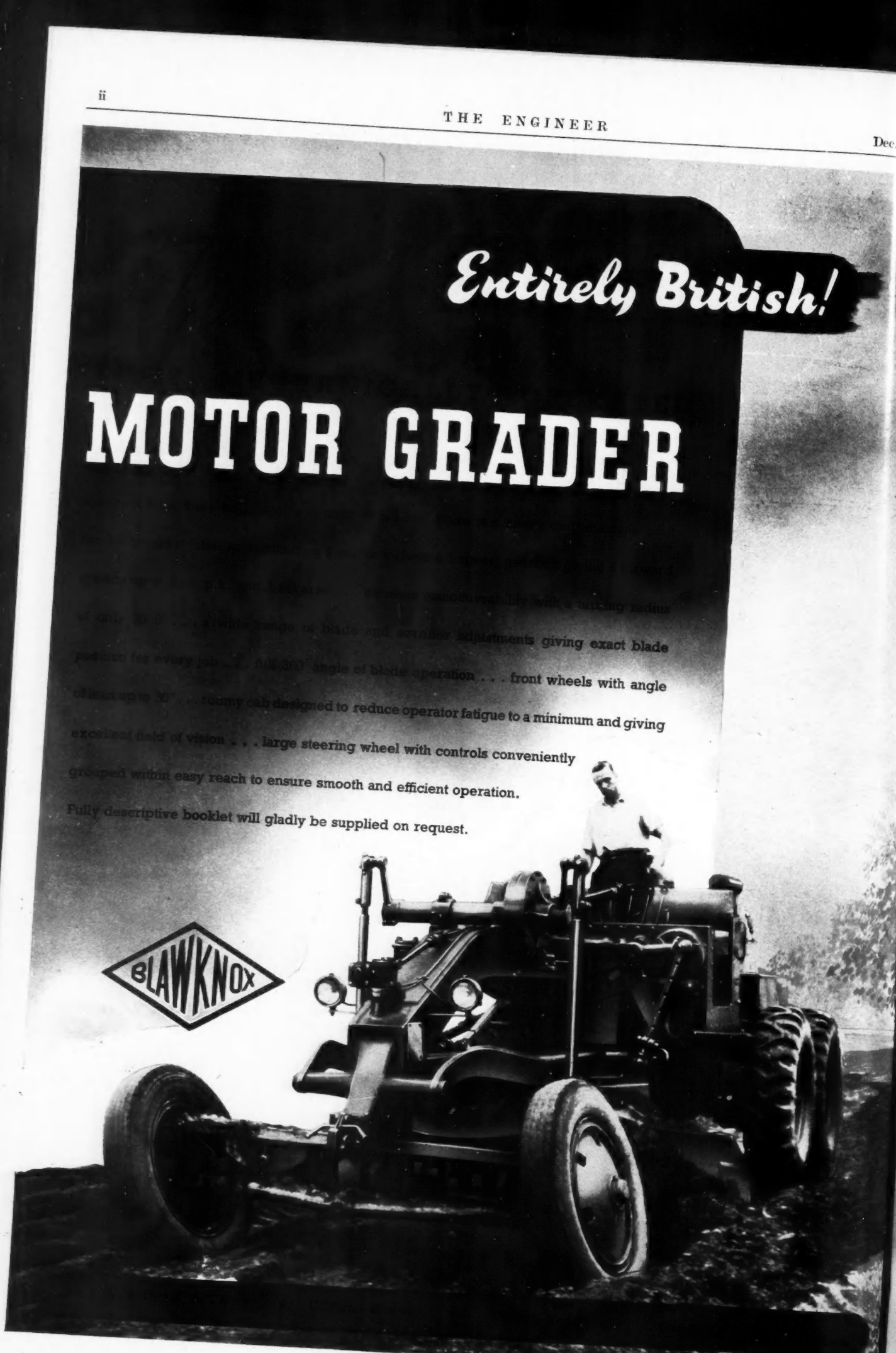
Established 1856 | Price 1s. 6d. By Inland Post 1s. 9d. | Registered as a Newspaper

Entirely British!

MOTOR GRADER

Advance-retard of blade and scarifier adjustments giving exact blade pattern for every job . . . full 360° angle of blade operation . . . front wheels with angle of lean up to 30° . . . roomy cab designed to reduce operator fatigue to a minimum and giving excellent field of vision . . . large steering wheel with controls conveniently grouped within easy reach to ensure smooth and efficient operation.

Fully descriptive booklet will gladly be supplied on request.



A Seven-Day Journal

The British Steel Founders' Association

THE British Steel Founders' Association held its annual dinner at Claridge's Hotel, London, on Wednesday evening of last week, the large company present including representatives of member firms and a number of distinguished guests. Mr. Frank Rowe, chairman of the Association, presided, and in proposing the toast "British Industry," emphasised the fact that not only did British industry support a nation of 50,000,000 people, but it had been the mainspring by which a population of over ten times that number had been enabled to rise to standards of living which otherwise it could never have reached. In no other country, Mr. Rowe claimed, were the difficulties which hampered industry so great as in ours, but in no other country were those difficulties so intelligently faced and so manfully overcome. Sir Robert Sinclair, President of the Federation of British Industries, replied to the toast, saying that one of the main problems facing most industries to-day was shortage of materials. Recriminations, Sir Robert observed, were a luxury which could not be afforded, and the problem was how to minimise the braking effect on production likely to result from the shortage of essential materials. It would be a great thing if the reimposition of controls and excessive regulations could be avoided, but the shortages might be such that some controls would become inevitable. Sir Robert hoped, however, that controls would be kept to the minimum and that the experience of industry would be fully used. It would be the endeavour of the F.B.I., he said, to ensure that everything it could do to that end was done. Viscount Davidson, President of the Engineering Industries Association, gave the toast of "The Steel Founding Industry," response to which was made by Mr. T. H. Summerson, vice-chairman of the British Steel Founders' Association, and the toast of "The Guests," proposed by Mr. D. W. L. Menzies, was acknowledged by Sir Alexander Ramsey, Director of the Engineering and Allied Employers' National Federation. A pianoforte recital by Mr. Louis Kentner contributed much to the pleasure of the evening.

Launch of the "British Adventure"

THE fleet of large-capacity oil tankers was further increased when the "British Adventure" was launched on December 12th from the Barrow yard of Vickers-Armstrongs, Ltd., after the naming ceremony had been gracefully performed by Mrs. W. Fraser. The vessel, which is the first of six large oil tankers building in this country for the British Tanker Company, Ltd., has a length between perpendiculars of 610ft, a breadth of 81ft, and a depth of 44ft 6in to the upper deck, and is designed to carry a deadweight of 28,100 tons at a service speed of 15 knots. The structure of the ship is all welded except for the seams of the bilge strake and the upper deck stringer angle, and she is the first vessel built at the yard for which the facilities afforded by the modernisation scheme have been fully used. The new welding shops and lay-apart spaces at the heads of the berths, together with cranes capable of lifting 40 tons, have allowed a large degree of prefabrication, and flat-of-bottom plating panels measuring 80ft by 40ft have been prepared ready for shipping to the building berth. The vessel is to be propelled by a single screw driven by a set of double-reduction, articulated geared turbines of Pametrada design developing a maximum of 13,750 s.h.p. and taking high-pressure superheated steam from two Foster-Wheeler boilers. Replying to the toast of "The Owners," at a luncheon following the launch, Sir William Fraser, the chairman of the Anglo-Iranian Oil Company, Ltd., said that the ship was the largest to join the fleet and was intended for long-haul carriage of crude oil from production points to refineries. Sir William gave many interesting facts relating to the size of the fleet, which, he said, would shortly reach 2,000,000 deadweight tons, and he disclosed that his company was now negotiating for the building of some 32,000-ton vessels. With reference to the oil industry, he commented upon the phenomenal rise in production to the present-day figure of 500 million tons per annum, and stated that the Anglo-Iranian Oil Company, Ltd., now contributed 40 million tons per annum of crude oil and its products.

Report of the Fuel Research Board

THE first report of the Fuel Research Board to be published since 1939 was issued last week by the Department of Scientific and Industrial Research, and covers the period 1939–46. The report contains a most comprehensive survey of the investigations made by the Board during the war years, and covers aspects of fuel application and economy ranging from flame warfare to domestic heaters. The report opens with an account of the Board's coal survey work, including investigations of the physical and chemical properties of seams and outcrops along with the defects and storage problems of opencast coal. During the war the Board was also concerned with the development of new hydrogen plant, principally to meet the demands of the balloon barrage and was at all times at the disposal of the Director of Hydrogen Production. Of great importance was the study by the Board of the Fischer-Tropsch process of synthesising oil from coal and the further development of catalysts. Another aspect of research mentioned in the report is that relating to the prevention of solid matter from being deposited on the external heating surfaces of boilers and other problems associated with steam-raising and power production. Work on similar lines has also improved the design of domestic heating appliances now in production. The well-known Government emergency gas producer for road vehicles and the later Government utility producer were also a result of extensive research by the Board conducted during 1939 and 1940, which is outlined in the report. Amongst the most important of special wartime projects undertaken was a study of the preparation and properties of fuel for flame throwers, fougasses, and flame and smoke barrages, along with new types of fillers for incendiary and mortar shells and bombs. The report covers many other investigations of interest, including camouflage of water areas with coal dust, smoke elimination from ships and power plants, atmospheric pollution, the production of solidified fuels, oxy-gas cutting, and the distillation of sea water.

Port of London Authority Report

IN the annual report of the Port of London Authority for the year ended March 31, 1950, it is stated that ships totalling 50,248,551 net register tons entered and left the port, which was 4,309,456 tons more than the 1949 total. The shipping which used the West Docks was 26,651,690 tons and 2,872,896 gross tons of ships entered the dry docks. The tonnage of imported goods, foreign and coastwise, was 32,597,761 tons, and the corresponding export figure was 40,740,998 tons, in both instances the totals representing an increase on the 1949 returns and a decrease on the 1939 totals. The report notes that steady progress was made during the year in restoring war-damaged transit sheds and in reducing arrears of maintenance, and that a start was also made on some of the major reconstruction schemes. Details are given of the work undertaken and of the contracts placed for modern additional equipment. A number of salvage operations were carried out, including the removal of a collier, a motorship and the raising of sixty small craft. To meet the river transport requirements of the Festival of Britain, the Authority has undertaken to construct and operate additional river piers and to improve existing ones. The condition of the Thames water, the report says, caused concern during the year, and it was considered that improvement would only result from a long-term plan to extend the existing sewage disposal works and to increase the reservoir capacity so that a greater flow of fresh upland water would be available when most required. Finally, it is recorded that educational authorities and the public made good use of the river and docks cruises, and throughout the year 17,000 passengers were carried on forty-four trips.

Coke Oven Plant at East Greenwich Gas Works

THE two new batteries of coke ovens constructed at the East Greenwich Gasworks of the South-Eastern Gas Board, were officially inaugurated by H.R.H. The Duke of Gloucester on Thursday of last week. The ovens, which were described in our last issue, have a total carbonising capacity of 1000 tons of coal a day. The site lay-out provides for the construction of two further batteries. His Royal Highness was welcomed by Mr. W. K. Hutchison, chairman of the South-Eastern Gas Board, who said that the ceremony originated from decisions taken more than six years ago by the directors of the former South Metropolitan Gas Company to carry out an extensive modernisation of the plant. Now that the South-Eastern Gas Board was responsible for the supply of gas in the whole of South London, the East Greenwich works had become even more valuable as a site where gas could be produced economically in large quantities from seaborne coal. Mr. Hutchison added that the putting to work of the coke-oven plant was a long operation demanding meticulous care. The first flames had been lit in August and the first trial charge of coal had been made two months later. But, he said, the tuning-up process could now be considered to have reached the stage when the plant was ready for full operation to meet the demands which would be made upon it. The Duke of Gloucester then formally inaugurated the plant by operating the ram discharging coke from No. 33 oven into the coke car. Thanks to His Royal Highness were voiced by the Minister of Fuel and Power, Mr. Noel-Baker.

Imperial College Vacation Work Scheme

THE sixteenth annual report on the vacation work scheme for students of the Imperial College of Science and Technology covers the year ended October 31, 1950. The committee responsible for the scheme not only helps students of the Imperial College to obtain experience with industrial firms at home and abroad, but also acts as the clearing house for the provision of training to students of British universities and colleges affiliated to the International Association for the Exchange of Students for Technical Experience. The report says that in 1950 there were 515 Imperial College students registered under the scheme, and that during the summer vacation they had, in the aggregate, nearly 2000 weeks' experience with British firms, and, together with students from other universities, 2500 weeks' experience with firms abroad. Students from the Imperial College were allocated to works in Austria, Belgium, Denmark, Finland, France, Germany, Holland, Norway, Sweden, Switzerland and the U.S.A. An interesting feature of the report is the reference to the close contact maintained with many of the British firms which co-operate with the committee. During the year the works and laboratories of sixteen of the firms were visited by members of the committee, with many useful results. The visits, for instance, keep the firms informed of the changes and developments taking place in the vacation work scheme, and also make it easier for the committee to give the best possible guidance to students in selecting work suited to their needs. Mr. J. Newby, Imperial College, Prince Consort Road, South Kensington, S.W.7, is the Superintendent of Vacation Studies.

The Development of the River Rhone

No. II—THE SEYSSEL PROJECT

(*Continued from page 551, December 8th*)

THE construction of the next project downstream from Genissiat, at Seyssel, some 10km distant, is now well advanced, and it is expected that the first turbo-alternator set will be in service next year. Although a much smaller scheme than Genissiat, the Seyssel project presents several points of particular technical interest, there being a number of innovations in both its design and construction. Its general lay-out is shown in the accompanying plan and section (Figs. 8 and 10), from which it may be seen that there are three Kaplan turbine groups, each of 15MW, in the power station, and the barrage itself is divided into three bays. On the right bank a training wall is provided and the head of the lock of a future navigation canal has been incorporated in the present work to facilitate the construction of the lock at a later date.

The location of the dam was fixed within fairly close limits by local conditions, the two governing factors being that for flood control it was necessary to have the barrage downstream of the left bank tributary Les Usses, and that since it was necessary to regrade the permanent way on the right bank, the barrage had to be at least 0·9km upstream from Seyssel railway station. The level of the railway (main line, Lyon to Geneva) was raised by about 3·3m at the dam, to bring it to a height of 1m above the top reservoir level. This elevation of level was carried out over a length of 3·2km.

The upstream limit of the Seyssel reservoir will at first be about 1500m downstream of Genissiat, but it is thought that eventually it will extend right up to that dam. The water from the turbines of the Leon Perrier power station will be free from sand and silt and will thus erode the river bed downstream in the tail-race channel. This erosion effect will be slowed down in ten or fifteen years' time, when the system of scouring the Genissiat reservoir will be brought into operation each year, to transmit the greater part of the river's natural discharge of solid matter. Eventually, the scour will cease, owing to the effect of the Seyssel reservoir at the foot of the dam. The top level of the reservoir of Seyssel will be 260·5 and that of the tailrace at Genissiat is at present 261·5. Thus the level downstream of Genissiat will eventually be lowered about 1m.

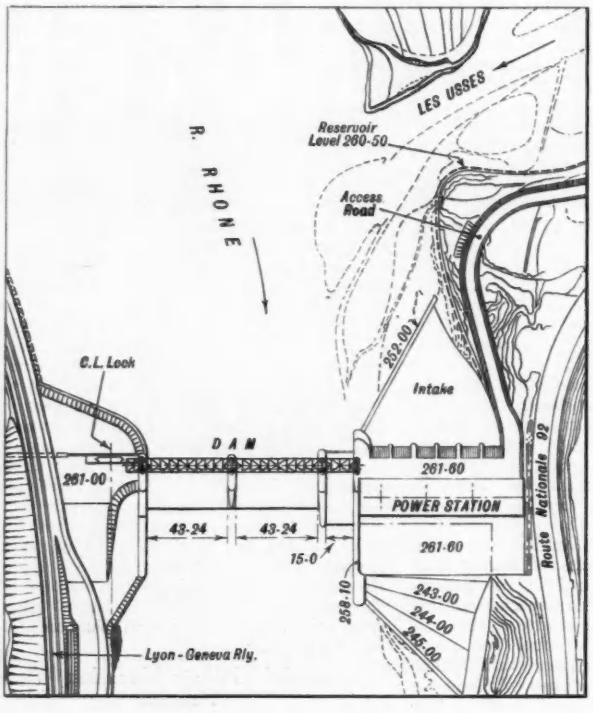


FIG. 8—THE SEYSSEL PROJECT

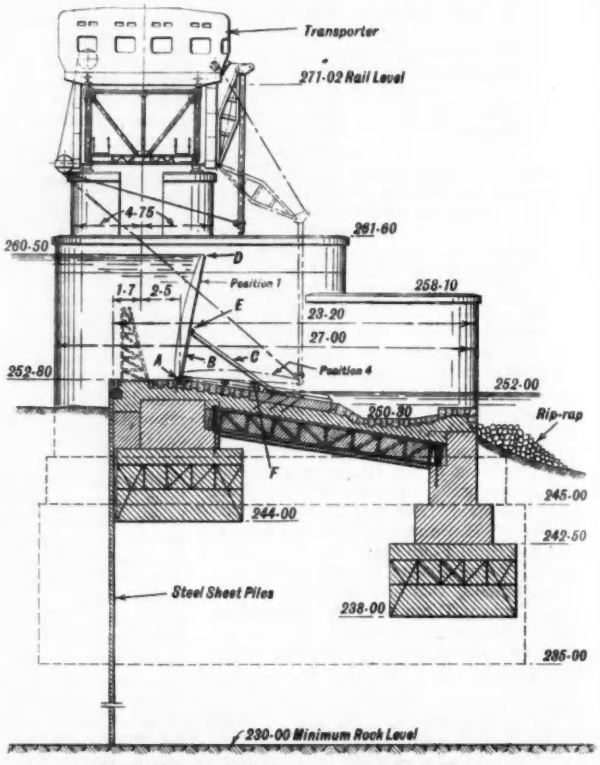


FIG. 9—SLUICE GATES AND TRANSPORTERS

DESIGN AND MODEL STUDIES

At the site of the Seyssel dam the alluvial deposits of the River Rhone form a surface layer 20m to 25m thick, under which lie sandstone strata of the Miocene period, which vary from a hard impermeable rock to one much softer and more or less porous. On the left bank there is a sandstone cliff rising 20m above the river. On the right bank the sandstone cliff was eroded by the river within geologically recent times, and the debris from this cliff forms a layer above the undisturbed strata. This formation caused some complication in the construction of the dam, particularly in the sinking of caissons, since large blocks of rock were encountered within the softer material.

To ensure watertightness of the completed structures a continuous screen of impermeable material has been incorporated in the substructure of the dam. On the right bank the zone of fallen sandstone has been sealed by a wall of concrete, 24m long and 1·5m thick, on the shore side of the future lock. The head of the lock was constructed with a permanent steel sheet piled cut-off, penetrating to rock, with the aid of which the lock, which will be 12m wide, will eventually be built.

A line of steel sheet piling has also been driven with as great a penetration as possible right across the upstream side of the dam, and then extended downwards in the regions where the permeable material was deepest by zones of injection. The method of injection used was the same as that employed at Genissiat, and consists of injecting clay at a pressure of about 10kgs. per square centimetre, to form two vertical screens, between which the sands and gravels are afterwards solidified by silification. At the power station the watertight screen was continued by extending the head walls of the turbine intakes down to solid rock.

Model tests on the barrage were carried out both at the C.N.R. laboratory at Lyon and at the Neyrpic laboratory at Grenoble. The main subjects studied with models were those connected with the flow of floods; the effects of scour on the river bed, the bottom of the dam and on the banks; intake of water to the power station without loss of head; desilting of the reservoir; and river flow during the construction period.

Amongst the results of the model tests may be noted the fact that the pier between the power station and the barrage (see Fig. 8) was built to project well beyond the power station, both upstream and downstream. This configuration ensures an even and direct flow into the adjacent turbine on the upstream side and gives a more favourable discharge in time of flood on the downstream side.

Another important result of the model tests was that the sluice next to the power station was built 2·6m deeper than the two main sluices, with a sill level of 250·85, to facilitate the passage downstream of river gravel. The sill of the power station intake, which is inclined across the river, as shown in Fig. 8, was then constructed with levels between 252 and 254 to avoid the entry

of stones into the turbines. A second reason for this arrangement was that the extra depth provided by this sluice gave a greater flow and it was thus possible to reduce the length of the spillway section by 5m while still achieving a maximum flood discharge of 3500 cubic metres per second at the normal reservoir level of 260·5. This reduction was important, since any extra length had to be excavated from the cliff on the left bank, the right bank being fixed because of the railway. The excavation and subsequent road diversion would have been an expensive task; with the present design the entire dam is still a little wider than the natural width of the river.

The deep sluice next to the power station is 15m wide and is closed by a double-lift vertical sluice gate. In cross section it has an upstream sill level of 250·85, followed by a slope of about 1 in 2 down to a level of 244; there is then a similar slope upwards to the downstream sill level of 246·2. In times of flood the severest scour will occur just downstream of this opening, so that the stream bed has been excavated to a level of 235m and protected with riprap.

Main Sluice Gates

The two main river openings are each 43·24m wide and are closed by pivoted sluice gates of a type developed by Monsieur Aubert. There are twenty gates, each 7·87m high, in each of the openings, which can be raised or lowered by one of two transporters which travel along the steel bridge above. This type of sluice gate has been used before in France, notably at the barrage of Vives-Eaux, on the Upper Seine, where a head of 4·55m is retained; the gates at Seyssel are thus considerably larger than their predecessors. The small width of the gates (2·158m) causes the hydrostatic forces which act on them to be transmitted directly to the sill of the barrage. The gates are shown in Figs. 9 and 11.

Each gate is of fabricated steel construction and has a yoke at its lower end which bears against a circular metallic "sill" (*A* in Fig. 9), round which it can turn. At about a third of the way up the gate it is pinned at each side to a strut *B*. The two struts *B* are welded together by cross members (see Fig. 11) and are themselves pinned at the sill *A*. The gate is supported by a prop *C*, which is hinged to the top of the struts at *E* and has a shoe at its downstream end, which can engage one of the three steel teeth of a large rack cast in the invert of the sluice.

To raise or lower the gate the bar *D* fixed across its top is gripped by the hook of the transporter and adjusted as explained below. When the gate is in operation, if the reservoir level should rise above a certain maximum, or if the gate is struck sufficiently hard by a piece of floating debris, it will rotate about the point *E*, the prop remaining in position. The yoke will then return to its former position at *A*, when the overturning force is removed.

When the gate is open it rests on concrete blocks *F*. To raise it, it is gripped at *D* by the double hook of the transporter and lifted. The shoe of the prop then passes successively over each tooth of the rack and, on releasing the pull, the shoe engages in the preceding tooth. To lower the gate, it is pulled up almost to the vertical position, where the shoe is guided on an inclined plane into a path to one side of the rack, the gate pivoting slightly about a vertical axis. Thus, on relaxing the pull on the gate the shoe of the prop passes down a guide track beside the rack. At its downstream end the guide track forms a return to direct the shoe back into line for lifting.

The top levels of the gates in their three positions are 260·5, 259·95 and 258·91, whilst when completely open the gates form, hydraulically, a sill at a level of 253·42. Watertightness between adjacent gates is obtained by fitting a strip of steel, bent to form a semi-circle of about 12cm diameter, down each edge of each gate. This strip is welded to the gate on the downstream side, but is free on the upstream side, so that there is a small half cylindrical space inside it, into which water can penetrate from the reservoir. Thus, when the gates are in operation, the hydrostatic pressure exerted on the inside of two adjacent semicircular strips presses them together and gives a watertight joint. On releasing the gates, and hence the water pressure, a small clearance (2mm) is produced between the two.

The method by which the transporters manœuvre the gates can be clearly seen from Fig. 9. They travel on a continuous steel bridge, 4·8m deep and 8m wide. The maximum reaction which a transporter exerts on this structure, due to both its own weight and the forces of lifting a gate, are 22 tonnes horizontal and 105 tonnes vertical. The transporters are electrically driven and can be controlled either from their cabs or from a control room in the power station overlooking the gates, where the movements of the gate will be reproduced on a model.

For maintenance, a steel-framed stoplog can be placed upstream of the gates (see Fig. 9) to close one of the passes. Alternatively, for the repair of a single gate, a limpet dam attached to the two adjacent gates can be employed.

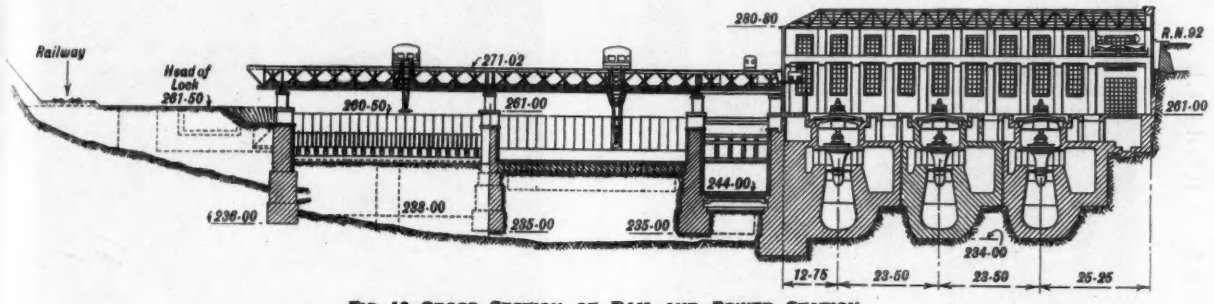


FIG. 10—CROSS SECTION OF DAM AND POWER STATION

Power Station

Although of comparatively small power, the Kaplan turbines at Seyssel are amongst the largest that have so far been constructed in Europe. The diameter of the runner, which has four adjustable blades, is 6·30m, and the reinforced concrete scroll casing is 20·7m across. Owing to the necessity of compensating the flow from Genissiat, at least during the first years of operation, these machines have been designed to operate between heads of 3·5m and 9·5m. With the minimum head each machine can develop a maximum power of 3000 h.p., with a flow of 90 cubic metres per second. The maximum head of 9·5m allows for an eventual scouring of the river bed of 1·25m downstream of the project, so that the maximum net head is 8·25m. Under this head the turbines can each develop a maximum power of 20,000 h.p. with a flow of

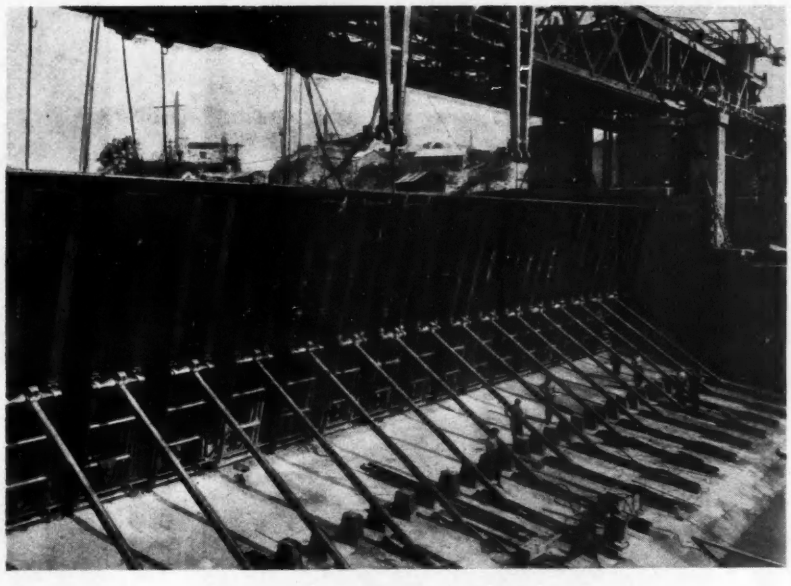


FIG. 11—SLUICE GATE INSTALLATION

PREFABRICATION OF TURBINE SHUTTERING AT THE SEYSSEL PROJECT

FIG. 14—SHUTTERING FOR DRAFT TUBE

FIG. 16—RE-ERECTION IN-SITU OF DRAFT TUBE SHUTTERING

FIG. 13—SHUTTERING FOR SCROLL CASING

FIG. 15—TRANSPORT OF SHUTTERING ELEMENT

220 cubic metres per second. The synchronised speed of the turbines and alternators is 75 r.p.m.

An interesting point about the design of the turbines is that they have been built to withstand, under exceptional conditions, a runaway speed of 180 r.p.m. for a period of three hours, which is the estimated maximum time required to cut off the corresponding flow of 440 cubic metres per second. This long period would be required to stop such a flow, since, as a measure of economy, no control valves have been installed at the turbine intakes and closure upstream can be effected only by the emplacement of a set of stoplogs placed in position individually by a transporter, across the two openings provided for each machine.

Although the exclusion of valves to regulate the turbine intakes was considered to entail a slight risk, it was justified on the grounds that the frequency of closing the intake would be very low, and that even with the alternator out of service and without normal governing two independent controls would be provided on the turbine itself, namely, the closing of the vanes of the guide ring (independently of the action of the governor) and the closing of the blades of the runner. For the turbines at Seyssel, should the vanes of the guide ring be jammed open due to a mechanical defect, the closing of the runner blades alone under these conditions would lead to a speed below normal. An independent control of the blades, operative at a higher speed than the vane control, is provided for this purpose. It would still be necessary to stop the flow, however, to be sure of stopping the turbine completely. These controls were considered sufficient to justify the omission of control valves, which would have been very expensive, two sluices of 97 square metres having to be closed for each turbine. A similar arrangement has been adopted for the André Blondel power station further downstream, which is described in the fourth part of this article. But in this case, since the load on the main bearings of the runner was about 1400 tonnes, as against 500 tonnes at Seyssel, a long period of running at an elevated speed could not be allowed, and it was decided to install plant to close simultaneously the three sluices of each turbine intake.

Two sets of stoplogs are provided at Seyssel, one of which can be used to cut off the flow as described above, and the other of which is for normal maintenance in still water. Some experiments on the closing of the turbines will be carried out when the first set is complete, since the complications of the problems concerned with are so great that model tests cannot be employed exclusively. It is hoped to obtain information from these tests on the possibility of stopping the turbine flow from the downstream side.

The three 15MW alternators are of the "umbrella" type and are enclosed and provided with forced ventilation. The diameter of the rotor is 9·95m. Each alternator generates at 10kV and is connected to a three-phase transformer situated on the downstream side of the power station, which feeds the 150kV grid of the Nord des Alpes region, through a switching station erected immediately downstream of the power station on the concrete platform above the draught tubes. There are no auxiliary sets in the power station, the auxiliary services being fed by three 500-kVA, 10kV/400V transformers. There will also be a further transformer of the same power, but transforming from 40kV to 400V, supplied by local power lines, and an emergency diesel generating set of 625 h.p. The cross section of the power station, Fig. 10, shows the dismantling and erection bay adjacent to group I and the well provided next to group III for stoplog storage.

Constructional Works

The construction of the project was started in 1946 and has been divided into four stages. The first of these was the building, using compressed air, of the river piers of the barrage and the head of the lock, and the excavation for the power station behind a wall of sheet steel piles. Secondly, the caissons on the upstream and downstream sides of the two left bank sluices of the barrage were sunk; this stage also included the closing of these bays with steel sheet piling, the construction in the dry of the two sills, and finally the erection of the sluice gates. During this phase of the works construction of the first bay (adjacent to the left bank cliff) of the power station was commenced, whilst the space reserved for the second and third bays was kept clear to allow the passage of flood waters for river flows above 1700 cubic metres per second. Fig. 12 shows the power station during the later part of this phase of the work.

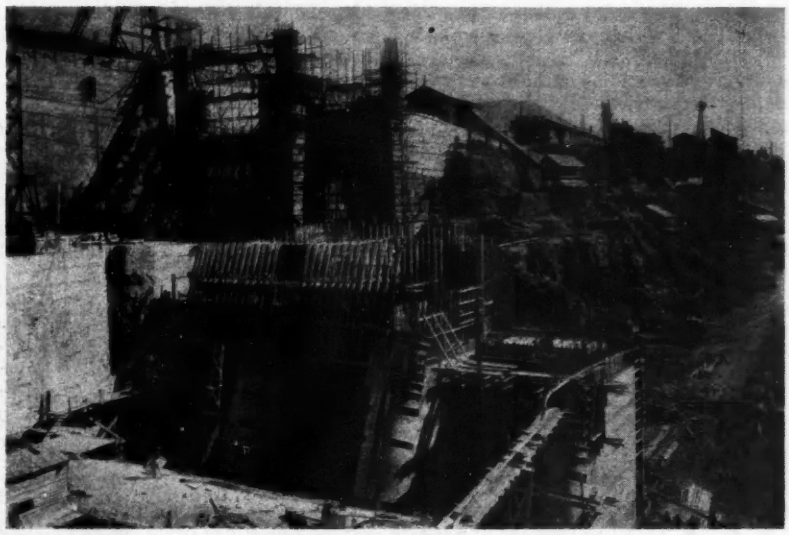


Fig. 12—Construction of Power Station—Groups 1 and 2

The third phase, which is at present in progress, involved putting the first main pass into service and closing the right bank pass with steel sheet piling for construction of the sill and mounting of the gates. Also the completion of the first turbo-alternator group is envisaged during this phase. The last stage of the works involves the completion of the second and third bays of the power station.

A timber service bridge was constructed just downstream of the dam and, in addition, the steel bridge carrying the transporters was erected as quickly as possible, to assist in the work of pile driving and erecting the sluice gates. A cableway of 6 tonnes capacity was also installed across the river at the dam site.

Aggregates are excavated from the river bed by a cableway dragline just downstream of the dam and crushed and screened in a plant on the left bank. The principal volume batch concrete plant is also on the left bank and has a capacity of 20 cubic metres of concrete per hour. There is a second concrete plant on the right bank. The bulk of the concrete has been placed with concrete pumps.

An innovation in compressed air work has been the employment of caissons, which, in addition to the normal air locks, incorporated shafts, 3·8m in diameter, extending from top to bottom and having a cutting edge at the bottom 10cm below the general level of the cutting edge of the caisson. These shafts were in contact with the air, so that the water level inside them was the same as that of the river. Grabs were used to excavate directly from these shafts, so that the workers in the caissons, when in loose ground, simply pushed material under the edge of the shaft to be removed by the grab.

This method was particularly convenient in the alluvial gravels through which most of the caisson sinking took place. Unfortunately, however, a slight tilt on the caisson was likely to produce very violent movements of air through the shafts, and several accidents, some fatal, were caused in this manner. As a remedy, small vertical pipes, each fitted with a valve, were installed close to the shafts, the bottom of each pipe being 10cm above the level of the cutting edge of the caisson. The valves of these pipes were left open, so that the pipes filled with water to river level in the same way as the shafts. Any movements of air which were produced were then taken up much less violently by the pipes. As an additional precaution only two shafts were provided for each caisson (the caissons each measured about 30m by 9m) instead of three, as originally planned, and the method was dispensed with altogether at depths greater than 12m and the shafts were concreted in.

Shuttering for the scroll casings and draught tubes of the turbines was prefabricated. This method of construction, which is illustrated on the page opposite, was used to save time, preparatory work at the power station being able to progress simultaneously with the making of the shuttering. The unit of shuttering was transported in sections and then reassembled in its final position. The illustration of the shuttering for the scroll casing (Fig. 13) shows that unit upside down in relation to its final position. It was prefabricated in this manner to facilitate the removal and erection of separate sections. Fig. 16 shows the shuttering for the upstream end of the draught tube of No. I group re-erected in position under a travelling crane made from steel scaffolding; the separate elements of the shuttering can be clearly distinguished in this illustration.

Altogether some 52,000 cubic metres of compressed air foundations have been constructed at Seyssel, and the finished work will have involved 280,000 cubic metres of excavation in free air, and placing 125,000

cubic metres of concrete and masonry. The barrage is now functioning to compensate Genissiat, and the first turbo-alternator set is expected to be in service next autumn. The two final groups will be completed the following year.

(To be continued)

The Esquimalt and Nanaimo Railway

By EDWARD H. LIVESAY

No. VI—*(Continued from page 556, December 8th)*

COMING to the work of the new diesel-electric locomotives on the E. and N.R., thirteen of which are now handling all the traffic on the line (twelve on the road and one switcher at Victoria) again—as was the case when I dealt with the former steam power in Part II—train "No. 1" is used to demonstrate it. It was standing in the Store Street Station, Victoria, on the day chosen for my trip, headed by engine No. 8004, and was made up of five cars—a box-car (freight), a mail ditto, two baggage and express cars, and a passenger coach at the rear. Not a heavy load—say, 275 tons—about the usual thing except on special occasions when for one reason or another there may be as many as eight cars. The weather, too, was repeating itself, in that it was "typically Victorian," but it was the very antithesis of the kind enthused about on page 453, inasmuch as it was typical only of a late March day of 1950's so-called spring—cold, blustery, rainy. Mr. Mantalini would have termed it "demnition demp, demn it"; it carried on the tradition established by a never-to-be-forgotten January and February, the most severe spell, it is said, experienced in Victoria since 1879, with officially recorded near zero temperatures on more than one occasion. Unofficially, but I am convinced actually, in outlying districts which included my own, it was below zero. "Tell it not in Gath, nor in the tents of Ascalon"—Victoria is not always as balmy as the Riviera, nor as mild as the Scillies, a delusion obtaining wide credence, and industriously spread by "boosters." Old-timers know differently.* But to get back to pleasanter subjects.

In the cab I found Enginemen Foster (senior engineer on the line) and Willey, the latter placing half his "stuffed seat" at my disposal, though, as it turned out, it was seldom used; I have to stand up to make notes, or my writing is indecipherable—and many notes were made. Train "No. 1" pulled out punctually at 10.30 a.m., moving gently away over the bascule bridge described on page 425, and once clear of it accelerated nicely past the E. and N.R. shops to the first stop at Russells, the original terminus of the line. Getting away again, I noticed that the former flimsy road-barrier arms across the Esquimalt Road, controlled from an adjacent signal-box, which I commented upon unfavourably earlier, as being to all intents and purposes useless, had been removed, and traffic lights substituted. Very sensible, seeing that such a barrier is no protection whatever to the trains, inasmuch as nothing will prevent a jackass behind the wheel of a car behaving like one at a level crossing, as will be exemplified farther on in this article. The removal of the arms therefore leaves nothing for him to break at Russells except his neck, comparatively a matter of little importance. Under way again towards the next station, Admirals Road, we passed very gingerly over another grade crossing—as they are known in N. America—at Lampson Street, where, *apropos* of the above homily, a little while ago a drunken moron drove probably "flat out" at 70 m.p.h. into the engine of a freight train, derailing it and regrettably killing his passenger instead of himself. Admirals Road was passed non-stop; another level crossing here, with the gates of H.M.C.S. "Naden," the naval barracks, adjacent, and a vista of Esquimalt Harbour and Dockyard opened out, with Yarrows No. 2 Yard in the foreground, and the great 1150ft Government dry dock; the former is now occupied by a lumber firm, no longer turning out ships as in the war years. After a brief halt at Esquimalt, "No. 1" continued on round the harbour to Palmers, crossing the Island Highway by a steel bridge at Craigflower, close to Portage Inlet, the innermost recess of Victoria Harbour. There is talk of connecting this shallow lagoon, much of which is a mud flat at low water, with Esquimalt Harbour, by a few hundred yards of ditch or pipe, which would greatly improve the cleanliness of all the waters concerned, these having been for a long time literally in bad odour with residents due to sewage pollution. The distance between the two bodies of water is so short and the benefit to be gained so obvious that the thing will probably be done sooner or later.

By this time I was becoming acclimatised

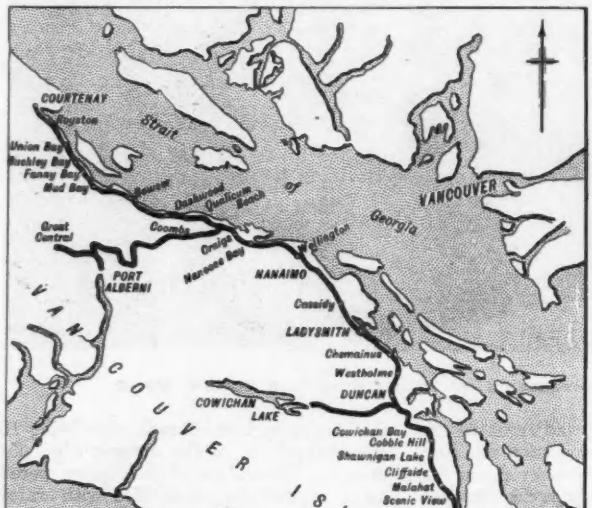


FIG. 26—ESQUIMALT AND NANAIMO RAILWAY

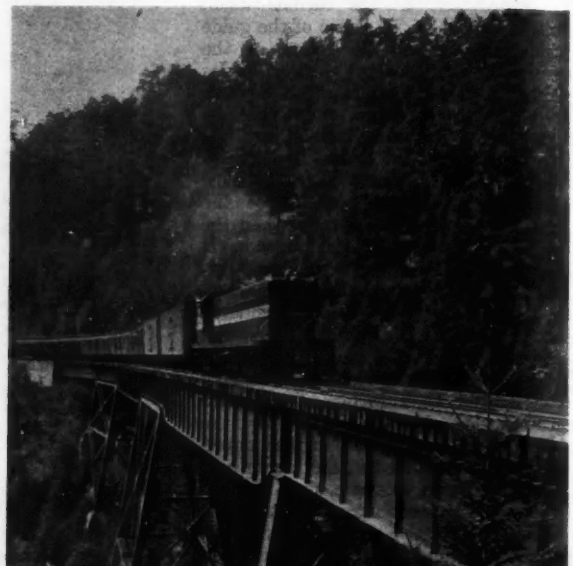


FIG. 27—CROSSING NIAGARA CANYON BRIDGE

* Neither is the climate of British Columbia as a whole invariably moist and mild—another very common misconception. The province covers a very large area, and climatic conditions differ widely according to longitude and latitude. It was 58 deg. below zero at Banff in the Rockies, for instance, during the recent detestable winter, and was reported to be 82 deg. below zero at Snag, near the B.C.–Yukon border, Canada's all-time low temperature record, which I will not vouch for, but am quite prepared to believe. Why not, when Britain's all-time record is 23 deg. below zero, registered at Blackadder, Berwickshire, in December, 1879, which many will find it difficult to credit, yet this was given in a letter from Kew Observatory, which I hold, so it is certainly factual.

to the cab and its fittings, which were of the usual simplicity. Grouped in front of the engineer were the controller, brake valve, sander, bell and horn, worked by a press-down handle; that was all. On top of the controller were three dials, two being concerned with the brake, and the third the ammeter, this being the only informative indicator from which it was possible to get an idea of the varying power output, and it was evident that the needle was never allowed to pass beyond the 1000 mark. On the fireman's side there was nothing, and it was clear my feelings were not going to be wrung in sympathy, watching him "persecute his vocation" on long gradients as has sometimes been the case during steam locomotive experiences. I had yet to find out I could manage the second without much trouble!

Brought up as I have been in a steam locomotive and motor-car world, and used to the methods of handling both, at first it came somewhat difficult for me to realise and feel that the engine was not being controlled primarily by the throttle of the diesel engine but electrically. Actually, of course, the diesel engine is in a way secondary, automatically adjusting its output to the current demand, and it was simpler for me to imagine a battery in the place of the diesel engine and generator! This mental kink ultimately straightened itself out.

Other impressions began to take shape, too, such as the riding, which was not quite so good as I had expected. Naturally, it

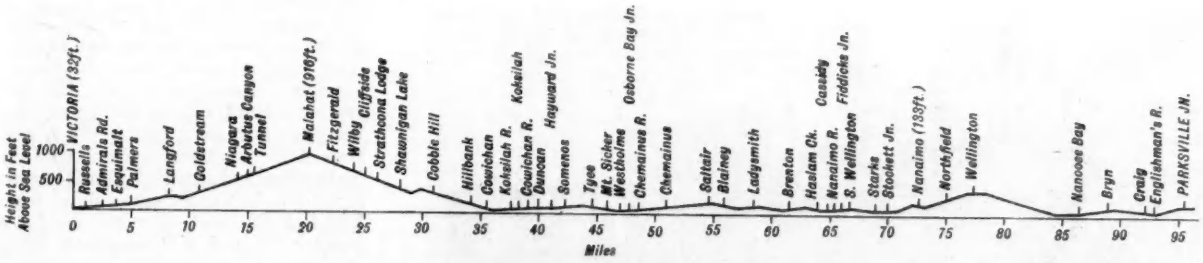


FIG. 28—GRADIENT PROFILE, VICTORIA - PARKSVILLE

just what the duties of a fireman on a diesel consisted of; he didn't seem to have much scope beyond acting as look-out on his side of the engine, the "look-ahead" being little better on No. 8004 than on a big-boilered steam locomotive. Subsequently it became evident that he did not live quite such a life of slippered ease as at first sight appeared, nevertheless, it cannot be denied that the crew of a diesel do not have a very strenuous time. I find it easier to conceive them dying of old age than of overwork.

MAIN CONTROLS

The cab itself is hot water heated. The manual controls are few. Two handles project from the controller box, the upper one termed the "throttle"—to make steam educated enginemen feel at home—though it is, of course, purely electrical. Beneath this is a smaller "forward-and-reverse" handle, and at the side are five buttons, the topmost controlling the fuel supply to the engine and the other four, various lamps. Beside the controller box is an auxiliary brake wheel, affecting one axle only. On the cab front is a "battery parallel" tell-tale, showing a permanent green light when the cells are properly connected and in operation, and an "engine starter" push button. A dial indicates the temperature of the cooling water, which should not exceed 160 deg.; should it rise above this the radiator shutters open automatically.

The ammeter segment dial is divided into two parts, white and red, figures up to 1000 being in the former and 1500–2000 in the latter; a notice plate on the box worded as follows explains the two-colour dial:

Time Limits

Amps.	Time
1050	No limit
1100	30 minutes
1150	20 ,,
1300	10 ,,
1450	5 ,,

The control of the train is to all intents and purposes entirely achieved by the "throttle" and brake valve. It looked to me that the handling of a motor-cycle is a much more difficult art than that of driving No. 8004. I can still do the first, so surely to goodness was far better than that of the old 4–6–0 "900" class steam locomotive, but there was more nosing than had been looked for, though how much of this was due to the engine and how much to the track it was difficult at first to decide—probably most to the latter. The unusually severe winter had played havoc with the road-bed, frost having gone in deep, "heaving" the ballast, things being made worse by the succeeding heavy rains, and as yet there had been no time to do much in the way of repair. Preparations were evidently in train to take steps about this, hundreds of creosoted ties lying alongside the track in readiness over many miles.

There was rather more noise in the cab than I had anticipated, though it was not objectionable; it was necessary to raise one's voice to avoid repetition. My sole previous experience of diesel silence and silky motion—with the 4000 h.p. twin-unit "400" between Chicago and Milwaukee, described in THE ENGINEER of September 27, 1940—had led me to expect too much from a 1000 h.p. semi-freight engine. A 0–4+4–0 built to achieve a maximum speed of 60 m.p.h. cannot be expected to ride as well as a 0–6+6–0 with a top speed of 117, with suspension designed to correspond. Further, forty-eight cylinders cause less disturbance than six! Other contrasts between the two engines also occurred to me. The cab of No. 5002, Chicago and N. Western, was furnished with two revolving mahogany armchairs that would not have disgraced a club smoking room; a shatter-proof glass window extended the full width of the engine, giving a 180 deg. view, and there was a soundproof door into the engine-room; one could almost have talked in a whisper and still been heard. No. 8004 had none of these amenities. My seat was half the fireman's padded bench, which ran lengthwise along the left side—quite comfortable, but not luxurious. The windows were little bigger than those found on the average steam locomotive, and gave no better look-ahead, and there was no door into the engine-room, yet a certain amount of noise filtered in. However, I was disinclined to be critical; No. 8004 was already beginning to induce respect, if not exactly affection—in comparison with a steam locomotive a diesel is cold-blooded, indifferent, unresponsive. My heart does not go out to it readily—I could as soon fall in love with a tram.

Though possibly no very high degree of mutual affection between No. 8004 and myself had as yet been felt by either party, respect—at any rate on my side—was growing. No. 8004 was doing her best, and it was a very good best, too. The cab was warm, clean and comfortable; there was no vibration from the six-cylinder engine, or from the wheels; the suspension was evidently good, and the constant curvature for which the E. and N.R. is notable was taken well, without any of those exasperating successive lateral jerks so often felt when a steam locomotive of basic design wrenches itself round a bend, after having entered it with a preliminary bang fit to sweep one off one's feet. Both track and engine made allowances for each other's idiosyncrasies apparently. When will somebody build a two-truck steam locomotive with a multi-cylinder, high-speed engine geared to the driving axle of each truck? That is what I have always looked for; then, and then only, perhaps we shall see steam power as smooth running as diesel-electric.†

Returning to the run, the profile (Fig. 28) shows a heavy gradient—Fagan's Hill—mostly 1·6 per cent, between Palmers and Langford; it was taken at about 20 m.p.h.—my figure; the engineer's was somewhat more optimistic, but I hesitated to adopt it offhand. In the absence of a speedometer I found it rather difficult to estimate the rate of travel accurately without any of the rough guides so useful on a steam locomotive. There was the same tendency to rather underestimate the speed that let me down so badly on the "400" C. and N.W.R. run, when it was glaring. I was generally about 20 m.p.h. out. On this climb the ammeter needle remained close to 1000. The outlook, seen through the driving mist and rain, was drab and somewhat depressing, and the snow-capped Olympics across the Strait hid their beauty behind cloud banks. It was early spring in this year of bitter memory 1950; no cheerful broom tinted the countryside with yellow; no golden sunshine flooded the cab; it was March, not August on this occasion. Following the Langford stop the track levelled, with an occasional minor hump, and No. 8004 ran easily for a mile or two past Langford Lake and flooded fields, the duck-hunter's paradise, until, nearing the 9-mile post the rising whine of the generator signalised the beginning of the long Malahat climb; 10 miles mostly at 1·5 per cent, with some stretches even stiffer. Goldstream was passed non-stop at 10.58 O.T.; then came Niagara Canyon (Fig. 27), spanned by a cantilever bridge 529ft in length and 500ft

† I forgot, Mr. Bulleid has done it with the "Leader" class; I am looking forward to a trip on one of them with keen interest. I am almost convinced that if the steam locomotive is to have an extended future the "basic design" must go—it is too crude.—E.H.L.

a.s.l., transplanted from the Fraser Canyon at 'Cisco many years ago. Climbing steadily up the gradient at about 25 m.p.h., round incessant curvature and through dripping rock cuttings, we crossed Arbutus Canyon by another steel bridge after negotiating a short pitch of 1·93 per cent, I rather imagine the most impressive figure on the whole line. This is a six-span bridge—two spans of 50ft, two of 75ft, and two of 106ft. One looks down into the rocky depths of both canyons to see the streams foaming out of the mountains in full spate, swelled by heavy winter rains and melting snow; in summer these water-courses are often dry. Half a mile beyond Arbutus Canyon one threads a little tunnel 100ft or so in length, probably the only one on the island, construction costs having led engineers to go round rather than through obstructions. The scenery becomes very fine here, with an inspiring glimpse into the depths of Finlayson Arm on the right, many hundreds of feet below the track; the Island Highway is close alongside. The window wiper was still flicking to and fro, but the weather was improving, the sun struggling through the mist and glistening on the patches of snow that lay alongside the metals and on the surrounding mountains, many of which are 3000ft in height.

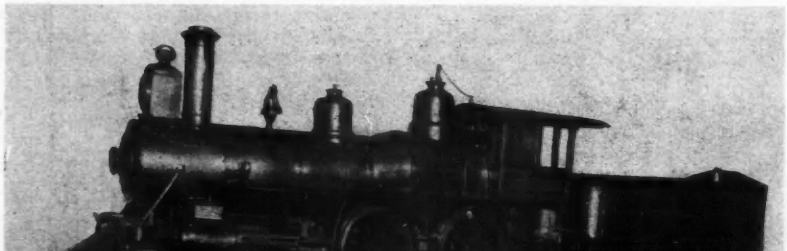


FIG. 29—4-4-0 LOCOMOTIVE, 1889

The Malahat peak, 916ft and 20 miles, was passed at 11.17, practically O.T., so the 10·5-mile climb had been done in roughly 22 min, an average of 28·5. A good performance, and considerably faster than I had estimated. On studying the figures in my notes, I cry "Peccavi!" Engineer Foster's assessment is evidently more to be depended upon than mine. But, after all, it ought to be—he has had far more experience of diesel-electrics than I! From this it comes out that No. 8004 made no bones at tackling the Malahat with 275 tons.

Once over the peak we accelerated quickly down the 1·53 per cent drop that follows immediately, and the weather definitely became more cheerful. It is wild country up here: uninhabited, with little in sight but fir-clad mountains. The scenery on the island is very fine, but I agree with Kipling—it would be more impressive if there were less of it. One can have too much of a good thing; one majestic mountain soaring up into the blue is more soul-stirring than fifty, and one Douglas fir is painfully like another—a million are apt to be boring. Kipling said: "I discovered that I was surfeited with scenery. There is a great deal in the remark of a discontented traveller: 'When you have seen a pine forest, a bluff, a river or a lake, you have seen all the scenery of Western America.' Men said that if I went to Alaska I should see islands even more wooded, snow peaks even loftier. That decided me not to go to Alaska." Very true; but I hope these articles will not result in the reader avoiding Vancouver Island, on which there is a good deal to look at beyond rocks and Christmas trees—diesel locomotives, for instance. On one point, however, Kipling was dead wrong, and as many fall into the same error I must correct it. I quote again: "Real estate agents recommend (Victoria) as a little piece of England—the island on which it stands is about the size of Great Britain." It is not like any English city I ever saw, the lay-out being typically Canadian (except here and there), though, of course, it is much more attractive than any other city in Canada! Further, Vancouver Island is only about one-third the size of Britain. For proof, superimpose Vancouver Island on Southern England; one tip would be at Chelmsford and the other at Land's End; one side on the Isle of Wight and the other at Swindon. This leaves a very considerable area uncovered—about two-thirds. The area of Vancouver Island is 12,408 square miles.

We passed Cliffside, 25 miles, non-stop; this is where the ceremony celebrating the completion of the line took place in 1886, when Sir John A. Macdonald drove the golden spike, and as No. 8004 drifted down past the spot I pictured the little 4–4–0 engine (Fig. 29) that had brought the two cars over the summit we had surmounted so easily, realising vividly how times had changed in the intervening sixty-four years; that little locomotive probably had made heavy weather of it. The photograph is of a beautiful scale model in the Archives Section of the Parliament Buildings at Victoria, built by Mr. Charles Fox, of the Stores Department, E. and N.R. I have no dimensions, but they are sufficiently obvious from the picture.

The outlook at Cliffside is probably much the same as it was on that occasion; there is no settlement and Shawnigan Lake comes into only occasional view through the bush that still covers the district.

Following the stop at Shawnigan Lake the downward gradient eases a little; there is even a rise of half a mile or so at 1·5 per cent, succeeded by a drop of equal severity to Cobble Hill, and 3 or 4 miles of 1·7 per cent to Hillbank and to the foot of the descent at Koksilah. So much for the Malahat—10½ miles up, 16½ down—well might old-timers doubt the feasibility of a railway over this barrier, in the light of engine limitations of those days. It was a tough nut to crack then.

Inquiries brought admissions from the enginemen that the cabs of the new engines were improvements on those of the old steam locomotives, "all the comforts of home" being available—sunshades over the windows, heaters, linoleum floor covering, window wipers and cleanliness, to say nothing of draught exclusion. Ordinary clothing can be worn by an observer; one can finish a trip and "shove off ashore" without the risk of being refused admission to an hotel. Life is simpler, as are the controls and the attention *en route* demanded by the engines, and the former can be quickly learned by men brought up on steam. In the event of a pair of drivers slipping, a buzzer sounds in the cab, the power being automatically reduced until the slipping stops, when it goes on again to a degree in accordance with the position of the "throttle." Slipping is not likely to happen under ordinary conditions, and did not to my knowledge on the whole 170-mile trip, made on four engines. The whole 113 tons of engine weight is, of course, available for adhesion, but the axles are not coupled, and, for various reasons, one pair of wheels can fail to grip; sand is available for all.

Koksilah, at the foot of the Malahat, is an Indian reserve, and passage through this area calls for good look-out, due to the aborigines having a quaint little habit of getting drunk and going to sleep on the track, using the rails for a pillow—they will do it. One of the engineers told me that once he had noticed an Indian lying on the track when it was too late to do much about it, and he had lost his head—I mean the Indian, of course; E. and N.R. engineers never lose their heads. Incidentally, there are no cow-catchers worth mentioning on these engines, only a diminutive imitation between the two steps placed for the convenience of switchmen, so a trespasser, drunk or sober, can easily get subdivided.

Next came Duncan, a flourishing town, the centre of open farming country—that is, as "open" is understood on Vancouver Island; it is seldom open for long or far; Kipling's superfluous scenery generally gets in the way. A new stretch of the Island Highway is being built along here, crossing the Koksilah River on a fine steel bridge, and then by-passing Duncan, which was reached at 12.07, 1 min early; 40 miles in 97 min, with several stops, 24·9 m.p.h. Much express (parcels) and mail was handled here, calling for a lengthy stop; we left at 12.23 O.T. Five miles farther on, at Stratfords, a steel-concrete bridge is being built to carry the Island Highway over the line, to eliminate another dangerous grade crossing. Millions of dollars have been and are being spent on the main artery "up island"; grading, widening, curve reducing, paving, by-passing, bridge replacing, and so on, to make it more fit for modern traffic, which includes many buses and trucks. Thus it was hoped to lessen the number of accidents, but it would not seem to have had the expected effect. Rather the other way; the traffic travels faster than ever, and accidents at level crossings occur with monotonous regularity, the admonition "Stop—look—listen!" being totally disregarded by the reckless and thoughtless. At Chemainus, 51 miles, with its great lumber mill, by virtue of which the town exists, another new by-pass is being built, and I noticed many other places along the line where road machinery was at work; during the war all this was held in abeyance.

The big sheltered inlet with Ladysmith at its head comes into view now; gradients are generally easy on this stretch, though there is a sharp drop of 1·45 per cent through Blaineys toward Ladysmith, reached at 1.10, two minutes late. The ups and downs of this former colliery town were detailed in page 455; it is now dependent on lumber for prosperity, though oysters might be mentioned *en passant*! Just beyond Ladysmith the Island Highway crosses the railway on a

narrow wooden bridge, entry and exit being at 90 deg., and it was nothing out of the way for a car to crash through the splintered rails and land on the metals. A very fine steel-concrete bridge is being erected instead to do away with this hazard—good luck to it. Cars will now probably stage head-on collisions at the 135 deg. points—drivers ought not to be deprived of all fun on the new bridge.

Some long straight sections follow Ladysmith, about the first since leaving Victoria, and the speed rose, but Cassidy was reached at 1.32, 12 min late, due to lengthy station work at Ladysmith. The slag heaps of S. Wellington came into view next, but little coal is mined here now. I do not quite know what the good people of these towns with a past live on, beyond taking in each other's washing, yet they carry on; probably lumber has something to do with it, and the war a good deal; that was an ill wind that has blown Vancouver Island a lot of good. There were still little patches of snow by the trackside, on this, the 29th day of March, yet the day felt mild after the rigours of the Malahat, and spring was in the air. And so into Nanaimo, the suburbs sprinkled with new post-war houses, to meet southbound train "No. 2" and come to a stand at 1.52, 7 min late; not a very vital matter on the E. and N.R.—73 miles in 202 min, 22 m.p.h. Not meteoric, but it was all the schedule called for.

Nosing round the engine at the lengthy Nanaimo stop, the steam heating system came in for attention. Supply is taken from a Clarkson oil-fired boiler placed in a compartment behind the cab—in what would be the bunker of a tank engine. Its gauges can be studied through a hinged window in the back of the cab, and the control valves reached through the same fitting. The installation is a product of the Vapor Heating Company, of Chicago. The air horn is worked by a press-down handle in front of the engineer, and has a powerful throaty note very like a ship's siren. It bursts into song frequently on the E. and N.R., but is often disregarded, judging from the many smashes one hears of at grade crossings. Electric-light is another of the cab amenities that should be mentioned, with a lamp or two under the running board. Another thing, these engines are always run "engine first," to obviate awkward handling of the controls, which are all placed conveniently in front of the driver. This brings to recollection my Beyer-Garratt runs between Cricklewood and Toton in 1940, (as described in THE ENGINEER of October 3, 1941), one of which was done bunker first; during this the inconvenience of reaching controls, placed chiefly for "other-way-round" operation, was obvious.

Out of Nanaimo there is a heavy climb of 4 miles at 1·5–1·9 per cent to Wellington; it was taken at 15 to 20 m.p.h., with the ammeter needle as usual near the 1000 mark; then down at somewhat easier inclination to water level round the shores of Nanoose Bay, at which there is a sawmill in operation in place of a larger one burnt down some years ago. After this the line becomes a comparatively simple affair, with straights along which No. 8004 began to pick up time until an "emergency brake" application brought the train to a sudden halt due to three cows disputing our passage. "Up island" farms are often of pocket-handkerchief dimensions, burnt and blasted with bitter toil out of the bush, and three cows might be a farmer's entire herd, so Bossy is given every consideration if she grazes on the right-of-way. It was a typical vignette of the E. and N.R., and as such will linger in my memory. A sudden stop—all heads out of windows—shrill objurgations from the herdswoman, probably the farmer's wife—three cows tangled up in a barb wire fence—the highball, and we resumed the even tenor of our way to Parksville, where I got down and stayed the night—five hours in No. 8004's cab having been sufficient unto the day. Time, 3.21, six min late; 96 miles in 291 min, 20 m.p.h.

(To be continued)

The Graphite Low Energy Experimental Pile (Gleep)

As a result of the recent decision to release information on atomic energy, we have received a report from the Ministry of Supply which describes the essential features of the graphite low energy experimental pile (Gleep) at Harwell, and gives some account of the experimental work done with it since it began operating on August 15, 1947.

The Gleep is a slow neutron reactor using graphite as a moderator and natural uranium and uranium dioxide as fissile material. It was constructed to meet two main requirements. The first was to run at as high a power as possible without elaborate cooling arrangements. High power was needed so that radio-active isotopes could be produced in Gleep until such time as the larger Harwell pile (BEPO) became divergent. The second function was to compare slow neutron absorption cross-sections of the elements by the pile modulation method.

As a later development it was found that Gleep could be used to provide an accurately known and reproducible thermal neutron flux in the range 10^6 to 10^8 neutrons per square centimetre per second. This flux can now be used to determine activation cross-sections.

General Description

As shown in Fig. 1, the pile is built in the form of a right octagonal prism of graphite lying on one of its sides. The reacting core is cylindrical (length 5·24m, radius 2·86m) with the uranium rods lying horizontally in the form of a line lattice of pitch 7¼in; the reflector forms the remainder of the octagon, the lower corners of which are filled in with graphite introduced for constructional reasons only.

The total quantity of graphite in the pile is 505 long tons. This material is stacked in forty layers, each layer being built with graphite blocks stacked in such a manner as to resemble a parquet floor. The graphite blocks are of two standard kinds, each measuring 7¼in by 7¼in by 29in. Various non-standard and half blocks are incorporated, but leading dimensions of all blocks are based upon the fundamental "pitch" unit of 7¼in. In some blocks the edges are chamfered, and grooves are cut in other blocks, so that a lattice of diamond-shaped holes of 1·85in side runs through the pile from *A* face to *C* face (Fig. 1).

The reacting core is loaded with uranium metal up to a radius of 1·75m, the outer region being loaded with uranium dioxide. The uranium metal is in the form of cylindrical bars, 12in long by 0·9in diameter, and is sprayed with aluminium of 0·003in thickness to prevent the escape of recoil fission products. The uranium dioxide is pressed, in order to increase its density, into pellets 1·60in in diameter and 2in long. These pellets are wrapped in paper containers and inserted in batches of six into aluminium cans of 0·01in thickness. This arrangement makes a uranium dioxide cartridge 12in long by 1·62in diameter, weighing 2·6kg. The Gleep contains 12 tons of uranium metal and 21 tons of uranium dioxide. There is a 3ft air space between the sides of the graphite structure and the inside of the protective or "biological" shield. This gap allows access to the inside of the pile if the necessity arises for the removal of any of the uranium cartridges. The concrete biological shield is 5ft thick around the sides and is 4ft thick on the top of the pile. On the *B* face of the pile there is a hole in the shield which is filled by graphite blocks to form a square section thermal column of 5ft side and 7ft long. There is a large access hole on the top of the pile so that an additional thermal column can be stacked on the top of the pile if it is required.

There is an elementary ventilation system for the pile, capable of delivering 5000 cubic feet per minute of air. Its function is to remove active argon from the pile and to provide some cooling of the uranium cartridges. The air is forced by the baffle on *A* face to flow over the uranium cartridges and is extracted by a suction fan on the top of the pile. When the ventilation system is operating it is arranged that the pressure inside the pile is always less than atmospheric, which ensures that there is no leak of radio-active air into the building. The air is ejected through a short stack on the roof of the building (the top of the stack is 60ft above ground level) and, when the air has diffused to ground level outside the building, its activity is below the tolerance level.

By using the air cooling system the pile can be run at a power of 100kW. The Gleep has an excess effective reproduction constant of 2×10^{-3} when all absorbers are removed from the pile. This excess k is controlled by four cadmium rods which move together as shown in Fig. 1. These four rods are known as the coarse control; the single rod shown in Fig. 1 is used as a fine control. All the control rods can be moved up and down by electric motors which are situated on the outside of the pile and operated from the pile control room.

In addition, there are two sets (each consisting of three rods) of emergency shut-down rods. These cadmium rods are held right out of the pile when it is operating by magnetic clutches. If the pile power rises above a preset level a trip circuit cuts off the current to the magnetic clutches, and the emergency rods fall into the pile under gravity. On the end of each shut-down rod shaft is a disc keyed to the shaft and positioned to rotate between the poles of four electro-magnets to form an electric brake. As the rods approach the "fully in" position the magnets of the brake are energised and the rod motion is retarded gently to a halt.

To indicate the position of the control rods in the pile two transmitter magslips (driven through gearing so that one rotates fifty times as fast as the other) are mounted near the drive motors. These transmitters are electrically connected to receivers in the control room, so that direct readings of the positions of the rods are given on two dials, whereby the position of the rods can be read with an accuracy of ±1mm.

The power level of the pile is measured by six ionisation chambers of 5 litres volume, containing boron trifluoride gas at a pressure of 20·7cm Hg. Three of these chambers are used for pile control, and the other three are used to operate the emergency shut-down mechanism. All the chambers have pre-amplifiers attached to them, the main amplifiers being in the pile control room. Initially, as the pile power is raised from zero the resistor in series with a chamber is changed, so that the chamber measures all powers up to 1kW without any change of position; the resistor can be changed by operating a wafer switch outside the pile. Above 1kW the chamber is wound out of the pile successively to two preset positions, in which the neutron fluxes are factors of ten and one hundred times lower than the flux at the original position. In this way, with only three positions for each chamber, six decades of pile power can be measured. It will be seen

from Fig. 1 that there are eight ionisation chamber holes in the pile. The two additional holes are used for experimental work; one of them is used permanently for work with the Gleep oscillator.

Rough temperature measurements are made at four points in the pile by means of resistance thermometers. Two of these thermometers are strapped on to uranium cartridges near the centre of the pile, one is embedded in a uranium dioxide cartridge, and the remaining one is embedded in a graphite cylinder which has been lowered down one of the vertical experimental holes. The temperatures are recorded continuously in the control room, and it is arranged that if the temperature of the uranium metal cartridges exceeds 60 deg. Cent. the pile is automatically shut down.

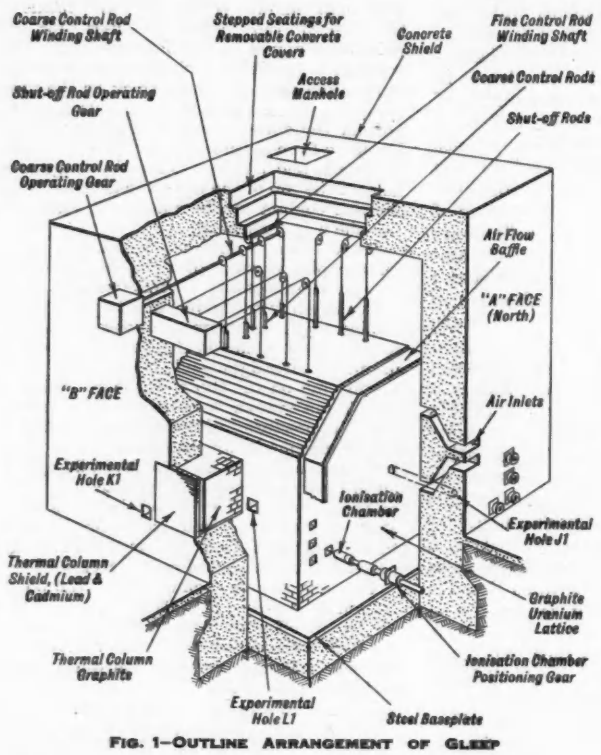


FIG. 1—OUTLINE ARRANGEMENT OF GLEEP

Gleep has only seven experimental holes, details of which are given herewith.

(1) Hole J_1, running from face A to face C through the centre of the pile, is 3in diameter. Since this hole is along the axis of the pile, and therefore parallel to the uranium holes, it is used for pile oscillator work.

(2) Hole J, running from face B to face D through the centre of the pile and thermal column, is 3in diameter.

(3) Hole K, to one side of the thermal column, running from face B to face D, is 5in by 4in. The maximum slow neutron flux in this hole at 100kW is $3{\cdot}0\times10^{12}$ neutrons per square centimetre per second, and this hole was used for the manufacture of radio-isotopes when Gleep first began operating.

(4) Hole L_1, to one side of the thermal column, running from face B to face D, is 8in by 8in. This hole can be used for testing the effect on the reproduction constant of the pile of inserting large quantities of material.

(5) Hole W, running from top to bottom of the pile through the centre, is 3in in diameter.

(6) and (7) Holes X and Y, running from top to bottom on each side of hole W, are 4½in in diameter.

Although in the foregoing list holes J_1, J and W are all stated to pass through the centre of the pile, they are in fact offset from each other by half of a lattice pitch.

TEMPERATURE AND PRESSURE COEFFICIENTS OF GLEEP

Soon after Gleep started operating the pile control rods were calibrated so that the amount of k they took up when in a given position in the pile was known. This was done by first balancing the pile with the control rods, until it was running steadily at low power, then withdrawing the control rods a measured amount, at the same time observing the rate of rise of pile power. From a knowledge of the number of delayed neutron emitters, the half lives of these emitters and the rate of rise of pile power, it is possible to calculate the change which has been made in the effective reproduction constant [1].

Then shortly after the pile started operating a run was made at 100kW without the air cooling system on. As the temperature of the pile rose, the control rods had to be withdrawn, to keep the power at 100kW. From the calibration of the control rods and the measured temperature rise the temperature coefficient of the pile was deduced. The temperature coefficient depends on the temperature distribution in the pile, but for a pile running without any cooling the temperature is, of course, highest at the centre and falls off towards the edges in much the same way as the thermal neutron flux does. For such a temperature distribution and for the same change in the graphite temperature as in the uranium temperature at the centre of the pile the temperature coefficient was found to be given by:

Change in effective reproduction constant = $-2{\cdot}9\times10^{-5}$ deg. Cent.

It should be noted that the pile has a negative temperature coefficient, which prevents the pile from rising to a very high temperature if, for example, the control system should fail. In fact, since the excess k of Gleep is only 2×10^{-3}, a temperature coefficient of $2{\cdot}9\times10^{-5}$ deg. Cent. means that the pile could only rise 70 deg. Cent. in temperature before all the excess k disappeared.

The pressure coefficient of the pile was measured by allowing it to run steadily at low power for about half an hour, and then setting the control rods in position. Next, with all the holes in the pile shield closed as well as possible, the extractor fan was switched on, putting the pile under 3·5cm of water suction (the mean value as recorded by a manometer on either side of the pile). The rise in pile power was observed for fifteen minutes. From the rate of rise of pile power the pressure coefficient was calculated and the answer obtained was capable of being expressed as:—

Change in effective reproduction constant $=-6{\cdot}5\times10^{-6}$/millibars.

This coefficient is also negative, since an increase in atmospheric pressure increases the amount of nitrogen in the pile and reduces its reactivity.

HIGH POWER RUNNING

To check that no dangerous amount of activity was escaping from the stack at high-power running, a 20 atmosphere Argon chamber was installed in the top of the stack to measure the gamma activity of the effluent from the pile. During the initial runs at high power it was noticed that, not only did this chamber give a higher current than would be expected from the Argon 41 activity, but also that this activity built up with time when working at a constant power level. This observation suggested that fission product activity was escaping from the uranium in the pile and the following experiments confirmed this fact.

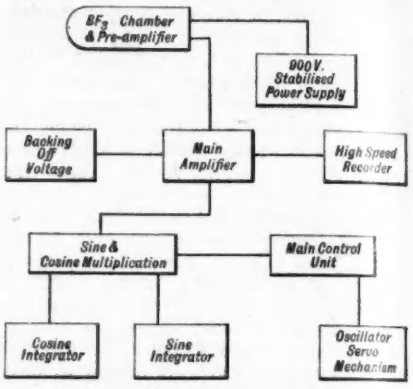


FIG. 3—BLOCK DIAGRAM OF ELECTRICAL EQUIPMENT

An aluminium tube was placed through the J hole of the pile. Arrangements were made to pass air through this tube and then over a Geiger-Müller counter. With the pile running at constant power a given flow of air was passed through the system and the background counting rate due to the Argon 41 was determined. A small foil of bare uranium of known area was then put into the centre of the tube and the counting rate due to the fission products carried off from the foil was obtained. This bare foil was then replaced, first by samples of the aluminium-sprayed uranium rod, and secondly, by a uranium dioxide cartridge. The results of this comparison of bare uranium with the two types of cartridge used in the pile showed that whereas the aluminium spraying was 99·5 per cent efficient, the uranium dioxide cartridges were allowing gaseous fission products to leak into the air stream at a very high rate.

Because of these results the channels of the pile containing the uranium dioxide cartridges were blocked off from the air stream. Since they form the outside ring of the pile where the neutron flux (and therefore the heat output) is low compared with the central channels, this modification did not in fact make the oxide

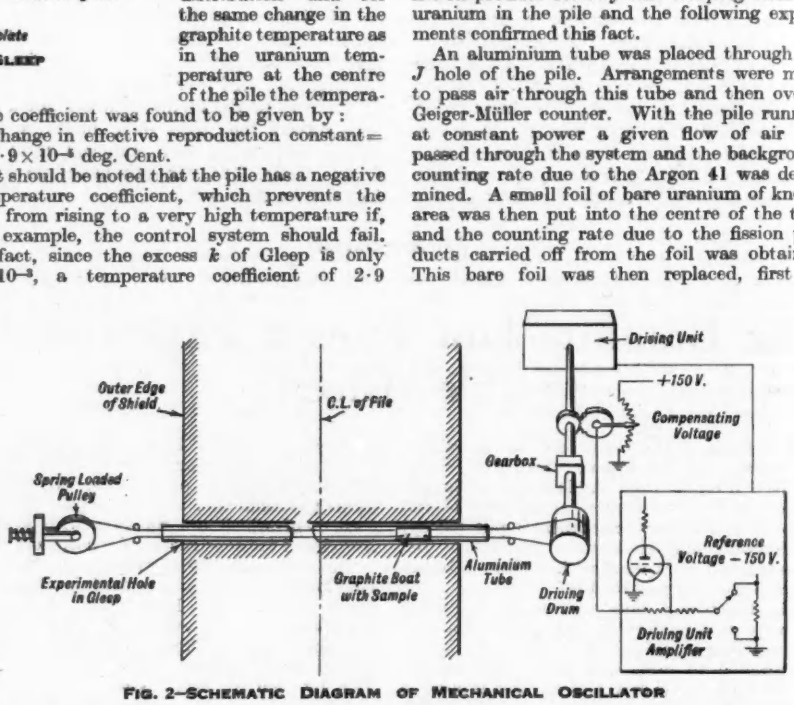


FIG. 2—SCHEMATIC DIAGRAM OF MECHANICAL OSCILLATOR

cartridges rise appreciably in temperature when running at 100kW. The discharge of fission products with the associated build-up of activity on the stack monitor was reduced by a factor of ten.

Experimental Work Done on Gleep

Most of the experiments described were done with the Gleep oscillator, a brief outline of which is given herewith. The oscillator takes small samples rapidly from the edge of the pile to the centre of hole J_1. These samples are moved in and out of the pile with periodic motion, which induces a periodic modulation in the power level of the pile. This periodic modulation in the power level is measured by a boron trifluoride ionisation chamber, is amplified and the resulting signal integrated. The integrated signal is a measure of the change in k produced by a sample, as explained below.

The samples are housed in a graphite container and can be driven from the outside of the pile shield to the centre of the pile by means of an electro-mechanical system (Fig. 2). Between these two positions the samples are moved in a regular manner so as to produce a periodic modulation of the pile power; the samples remain in each position for thirty seconds and take three seconds to move from one position to the other.

A block diagram of the electrical apparatus used in the measurements is shown in Fig. 3. The main control unit governs the motion of a sample in the pile. The current from the boron trifluoride ionisation chamber consists of two parts. The first part is a steady current, which produces a voltage across the resistor in series with the chamber. This voltage is balanced by a "backing-off" voltage, which gives a measure of the mean chamber current. The second part is a periodically varying current due to the periodic modulation of the pile by a sample. The voltage that this part produces across the resistor is amplified by the d.c. amplifier.

The voltage output from the amplifier is multiplied separately by sine and cosine factors of the same periodicity as the motion of the sample (this effect is achieved by having sliders moving with simple harmonic motion across resistor cards connected to the output of the amplifier), and is then fed into two velodyne integrators and integrated for one complete period. The integrated answers are thus proportional to the two fundamental components in the Fourier analysis of the pile modulation. If we consider only the first harmonic components in the pile modulation, it may be shown that the percentage modulation (the actual depth of modulation divided by the mean power level) produced by a sample is proportional to the change in k it would produce if placed at the centre of the pile[2]. Thus the integrated answers are a measure of change in k.

Bibliography

[1] H. Hurwitz, "Derivation and Integration of the Pile Kinetic Equations," *Nucleonics*, July 1949.
[2] A. M. Weinberg and H. C. Schweinler, "Theory of Oscillating Absorber in a Chain Reactor," *Phys. Rev. 74*, page 851, October 15, 1948.

Eliminating Precipitation from Cooling Towers

INTERESTING developments in the prevention of precipitation of water from cooling towers were demonstrated a week ago, when we visited the British Electricity Authority's research establishment at Croydon. There, a programme of research based on a theoretical study of cooling towers, side by side with practical work on an experimental cooling tower, has resulted in the evolution of a simple form of louvred eliminator (the elements of which are shown in Figs. 1 and 3), which is designed to remove all but a small percentage of the water droplets that would otherwise be emitted from the tower.

Evaporation of about 1 per cent of the circulating water is inherent in the operation of cooling towers. Originally it was thought that precipitation was caused mainly by condensation from the moisture-laden air discharged from the top of the cooling tower. That this theory was generally unsound was stated, on theoretical grounds, by Sir David Brunt and others. Then, in 1948, A. Blum* demonstrated that precipitation was usually the result, not of condensation, but of droplets of water carried over by the air stream leaving the tower.

The establishment of this fact was virtually the starting point of the researches at the B.E.A., Croydon, establishment. It was clear, in the first place, that the diamond-shaped "condensation openings," built into the top of certain cooling towers could be of little use, apart from decoration, since they depended on the theory that precipitation was mainly due to condensation. Useful information of a more positive kind had, however, been contributed by research work conducted under the auspices of the Incorporated Municipal Electrical Association, which showed that reduced precipitation was obtained by designing a larger tower than usual for any given duty, and, conversely, that overloading a given tower aggravated the trouble. But, apart from other objections, the expense of building larger towers provided a strong incentive towards discovering a cheaper and more positive remedy. The research work at Croydon was also assisted by the results achieved by Imperial Chemical Industries, Ltd., who developed a practical method of reducing the amount of water carried out of induced draught cooling towers. Briefly, the I.C.I. system involved the fitting of a non-splash water distribution system and a section of non-splash packing, with the object of inhibiting the formation of drops.

The experience gained from this system was made available to the British Electricity Authority, who adapted the method to suit its natural draught cooling towers, and, accordingly, modified a tower at Darlington power station, in 1949. The success of this experiment encouraged the authority to arrange for similar alterations to be made to the two other towers at the same station. Although a great deal of useful information was gained from this work it was felt that a cheaper and simpler remedy should be sought for the cooling towers at other B.E.A. stations.

To examine some of the promising alternative remedies that had been devised, a small experimental cooling tower was designed and built at Croydon. The tower has a square cross-section, about 4ft by 4ft; it is small enough to minimise the complications involved in the various measurements to be made, but large enough to accommodate a representative portion of the full-size devices under test, so that scale effects may be eliminated.

The simplified diagrams (Figs. 2 and 3) show the principle of the experimental tower. In this installation the fan on the right of Fig. 2 causes air circulation, the air passing up the square cross-section cooler on the left. As it rises the air traverses the triangular Davenport packing (Fig. 3) and abstracts heat from the water, which is circulated and distributed by the system outlined in the diagrams. Nearer the top of the column the moisture-laden air passes through the eliminator under test, the purpose of the eliminator being to abstract as much as possible of the water entrained in the air stream. Finally, before completing its circuit, the air, with its reduced moisture content, passes through a Calder-Fox scrubber, which removes the remaining water particles.

Three main quantities are measured in each test. The first is the water abstracted by the

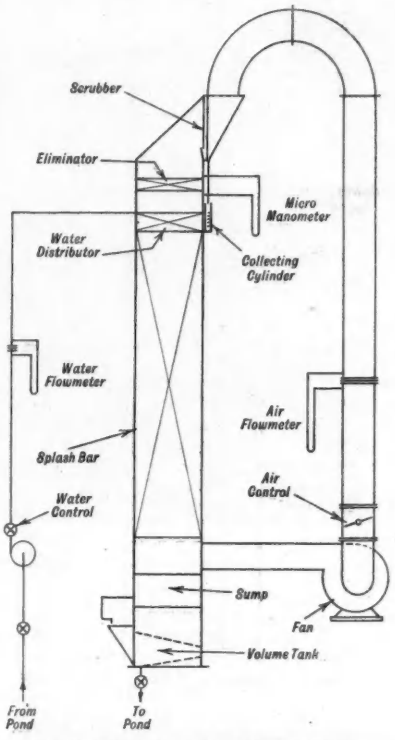


FIG. 2—DIAGRAM OF EXPERIMENTAL COOLING TOWER

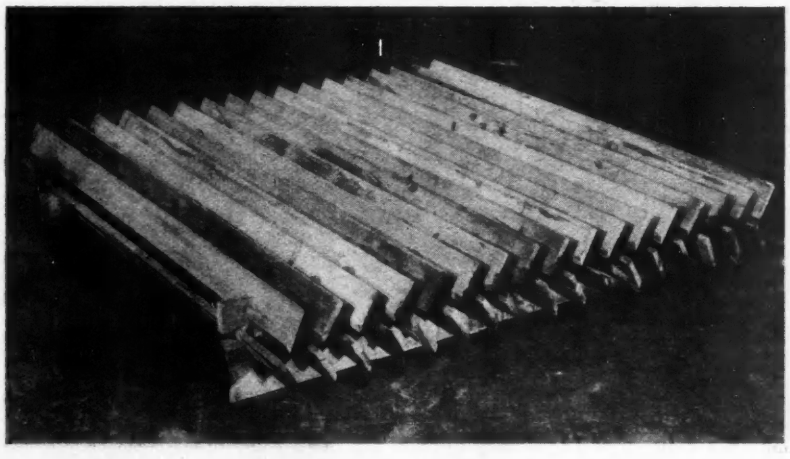


FIG. 1—LOUVRED ELIMINATOR

* The Engineer, Vol. CLXXXVI, page 128.

Calder-Fox scrubber, that is, the water which would otherwise be carried over. The second quantity is the water flow, which is measured by a "U"-tube manometer across a throat in the supply line. By a similar method, the air flow is measured to an accuracy of about ±2 per cent. Air and water controls are

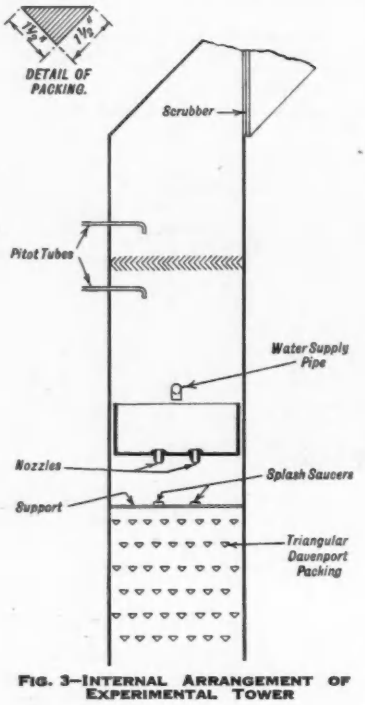


FIG. 3—INTERNAL ARRANGEMENT OF EXPERIMENTAL TOWER

provided, as indicated in Fig. 2, whereby the conditions of test can be varied within wide limits. The fourth quantity to be measured is the pressure drop across the eliminator on test. This measurement is made by pitot tubes in conjunction with a Chattock-Pye micro-

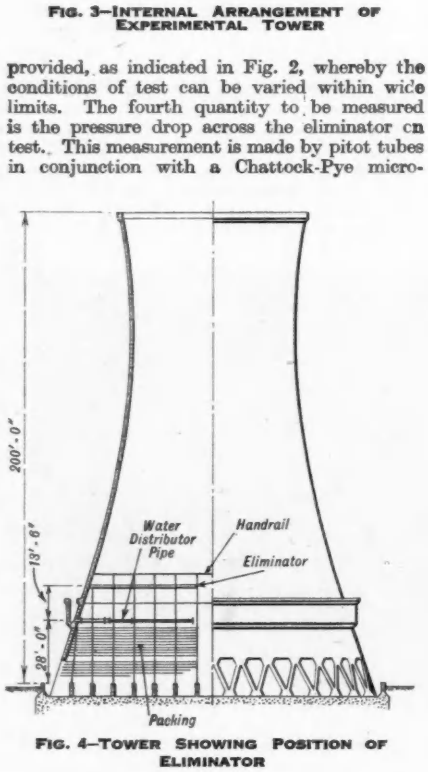


FIG. 4—TOWER SHOWING POSITION OF ELIMINATOR

manometer, which readily gives determinations accurate to better than 0·0005 in w.g.

Two of the possible sources of inaccuracy are either eliminated or controlled in the arrangement. First, recirculation of the air eliminates the error (a low reading on the micromanometer) that would arise, due to evaporation, if the air were allowed to be unsaturated. Secondly, if the temperature of the saturated air stream were greater than the ambient air temperature (i.e., in very cold weather) there would be an error in the opposite sense, due to condensation. For this reason the upper portion of the tower is lagged and the presence or absence of condensate is checked by measurements of the electrical conductivity of the collected water.

Within four months of the completion of the experimental tower in April, more than fifty different schemes for eliminating water carry-over were tested under strictly comparable conditions. From the results of these tests a simple arrangement was devised to remove practically all of the water droplets without presenting any objectionable obstruction to the air stream. This eliminator, the elements of which are shown in Fig. 1, consists essentially of a louvred wooden screen. The best results were obtained from an arrangement comprising two rows of louvres, each built up of 3in wide by ¼in thick wooden slats, with a pitch of 2¾in. The slats are inclined at 60 deg. to the horizontal. The two rows of louvres are staggered by ¼in and there is a ¼in vertical separation between the lower edges of the upper row and the upper edges of the lower row. In a full size cooling tower a screen built up of similar elements would be fitted horizontally to cover the whole cross-section of the tower, about 10ft above the point at which the water is introduced (Fig. 4).

The effectiveness of the eliminator was demonstrated during our visit to the experimental installation, by collecting the water (representing the quantity carried over) abstracted from the air stream by the Calder-Fox scrubber. The test was conducted first with the eliminator in position and then without it, the test conditions being kept constant throughout. The results indicated that, under the test conditions, which may be regarded as typical of actual service conditions, the eliminator removed all but about 5 per cent of the droplets in the air stream. It will be appreciated that the tests were performed on a portion of the full size eliminator and not on a small model, thus avoiding the necessity for corrections due to scale effect.

Compared with the scheme carried out at Darlington, it is estimated that the cost of modifying a cooling tower by installing the eliminator described above will be reduced by more than 75 per cent, while the effectiveness of moisture removal will be slightly improved. A programme, which is to be put into effect in 1951, has been prepared for modifying those cooling towers operated by the British Electricity Authority that have been the subject of complaint.

All new towers constructed in built-up areas will be fitted with eliminators in the course of construction, so that they will not give rise to nuisance.

Further research will now be conducted with a view to reducing the size and cost of cooling towers and also to finding more durable materials for use inside the towers—for instance, woven glass in place of the usual wood packing.

Agricultural Machinery Exhibition at Earls Court

No. II—*(Continued from page 558, December 8th)*

THE Smithfield Club Show and Agricultural Machinery Exhibition, which was held at Earls Court, London, last week, attracted a large number of interested visitors, including many from overseas. By the time the exhibition closed, on Friday evening, it was stated that the total attendance on the five days was 49,381, compared with 42,623 last year, when the first post-war "Smithfield" was held. The firms exhibiting in the extensive machinery section of the Show reported, generally, some "record business," more than 40 per cent of the orders booked being for export. In what follows we conclude our description of some of the exhibits in that section.

The large number of tractors exhibited included most of the well-known British makes, and a few which are now being introduced to this country from the Continent. There were many light-weight tractors, which have been designed principally for market garden work, though a survey of the exhibition soon revealed that British agricultural engineering firms continue to keep in mind both the home and overseas requirements of heavy tractors. For land reclamation and clearance schemes there is an increasing demand for heavy tractors, a striking example of which is the "Challenger" Mark III, built by John Fowler and Co. (Leeds), Ltd., and exhibited on the stand of Marshall Sons and Co., Ltd., Gainsborough, with which that firm is associated. As shown in an accompanying engraving, the "Challenger" is a crawler tractor, particularly well suited to difficult earth-moving work. It is powered by a Meadows six-cylinder four-stroke diesel engine, developing 95 b.h.p. at 1550 r.p.m., giving, the makers claim, 82·4 h.p. at the drawbar. The main engine clutch is of the spring-loaded plate type, and provision is made for six forward speeds, ranging from 1·50 to 5·67 m.p.h. and four reverse speeds, between 2·08 and 5·13 m.p.h. At the first forward speed a drawbar pull of 21,100 lb is possible. The standard width of the track plates is 20in and the length of the ground

"CHALLENGER" CRAWLER TRACTOR—FOWLER

contact of each track is 94in. Other leading dimensions of the "Challenger" are: length overall, 13ft 6½in; width, 7ft 8in, and height to top of exhaust pipe, 8ft 10½in. Its weight in working order is approximately 23,600 lb.

On the same stand there was shown the Fowler Mark VF. diesel crawler with a winch attachment suitable for towing and hauling timber. This tractor is fitted with a horizontal single-cylinder, valveless two-stroke, solid injection engine, developing 40 b.h.p. at a maximum governed speed under load of 750 r.p.m. The winch controls, which can be worked conveniently from the tractor driver's seat, include a hand lever throw-out gear, which frees the drum for quick pay-out of the 75-yard ⅜in diameter steel wire rope, and a drum brake operated by a hand lever with a ratchet stop. To control the rope laying, horizontal and vertical guide rollers are provided, and a hinged frame anchor, with chain adjustment, prevents slipping on soft ground.

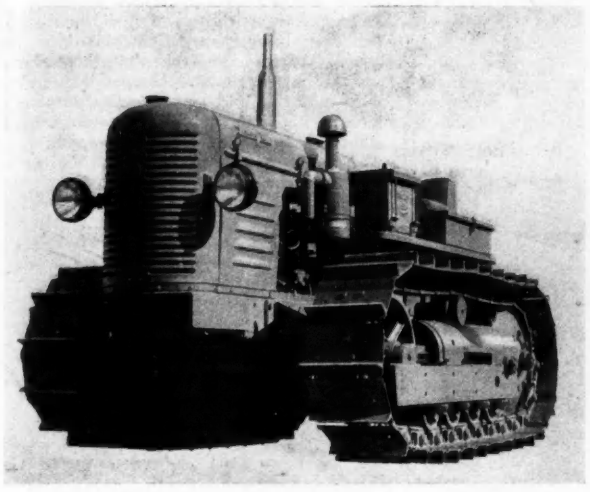
Another full track tractor, which was shown for the first time at Earls Court, is the "Dragon," which is illustrated on this page and which is now being put into production by Vivian Loyd and Co., Ltd., Bridge Road, Camberley, Surrey. This tractor is powered by a 40 h.p. four-cylinder diesel engine, fitted with electric starting. The gearbox provides for four forward speeds of 0·88, 1·8, 3·3 and 5·5 m.p.h., and one reverse speed of 0·75 m.p.h. The standard width of the track is 12in and steering is effected by a multiplate clutch and brake. The roller frames are mounted on a heat-treated cross-shaft and a balance beam at their front ends is designed to permit free movement within predetermined limits. With a total weight of 8200 lb, the "Dragon" is claimed to be capable of a drawbar pull of 7000 lb. The hull of the tractor is arranged to accommodate bull-dozing and other similar equipment, which can be operated by a power take-off, designed for a speed of approximately 550 r.p.m.

David Brown Tractors, Ltd., Meltham, Huddersfield, has recently made two additions to its range of tractors, both of which were exhibited. The first is the "Super-Cropmaster," which in many respects follows the "Cropmaster" design. The new model, however, is fitted with an engine capable of giving 20 per cent greater power. It is a petrol/paraffin engine developing 30 b.h.p. at 1600 r.p.m. and up to 38 b.h.p. at 2300 r.p.m. The makers claim that by a modification of the carburation lower specific fuel consumption has been made possible. The "Super Cropmaster" is a four-wheeled machine, and 13·00 by 28 pneumatic tyres have been fitted to give extra grip. Full length bonnet sides with vertical louvres are provided and another useful refinement is a removable wire chaff screen fitted to the radiator grille. Improvements have also been made to the power take-off and pulley, the power take-off being capable of speeds between 545 and 885 r.p.m. when the engine is running at 1600 r.p.m. Tested on 11·25 by 28 pneumatics, the "Super Cropmaster," it is stated, showed a drawbar pull of 4050 lb.

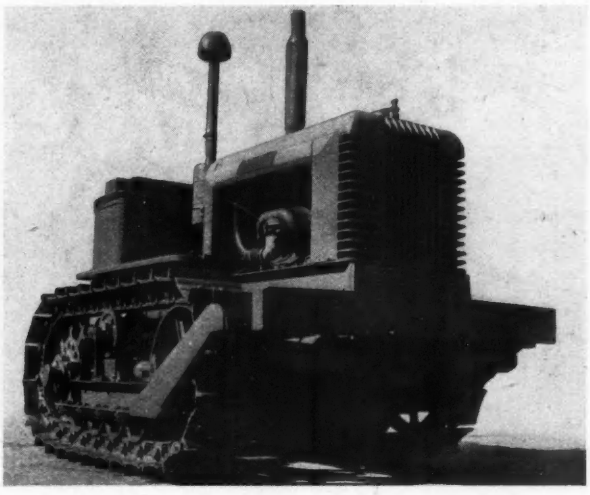
The second of the new tractors, which was shown by the firm, is the "Trackmaster" diesel, illustrated by one of our engravings. The David Brown four-cylinder diesel engine fitted to this tractor gives 31 b.h.p. at 1600 r.p.m. and 34 b.h.p. at a maximum speed of 1800 r.p.m. It is provided with C.A.V. injection equipment acting directly into a toroidal-shaped combustion chamber, which, it is claimed, enables the tractor to be started up instantly by the heavy-duty 12V starter motor. Transmission is through a six-speed gearbox giving six forward and two reverse speeds. Four alternative track widths, 40in, 48in, 56in, or 64in, are offered with the "Trackmaster," and steering is on the "Duotrack" principle with geared epicyclic differential. By this system power is transmitted constantly to both tracks, a particularly useful feature when the tractor has to negotiate headlands under load or when it is working in difficult conditions. One claim made for the "Duotrack" is that a controlled turn within a radius of 7ft to 8ft is possible. The maximum drawbar pull of the "Trackmaster" is stated to be 7500 lb. Another feature of the tractor is the four-speed power take-off, permitting a range from 468 r.p.m. to 1800 r.p.m., when the engine is running at 1600 r.p.m.

There are now fifty different implements produced for use with David Brown tractors, the latest addition being the Atkinson manure spreader, which was shown at Earls Court, and a photograph of which is reproduced on this page. The spreader, which can be supplied to take either 2 tons or 3 tons of material, is designed so that the weight of the load is partly transferred to the rear of the tractor. It is a p.t.o. operated implement constructed from 3½in by 1½in steel channel on a full chassis. The high tensile steel tine and impeller shafts are fitted with ball races, which are totally enclosed in bearing houses and lubricated through grease nipples, thereby greatly reducing the danger of obstruction or breakdown from the load adhering to these moving parts. In addition, a precision roller chain is fitted on machine cut sprockets. The width of spread is 12ft, the load being conveyed by an endless rubber belt supported by steel rollers. It may be added that the spreader can be converted into a self-unloading trailer by the removal of the tine shaft and impellers.

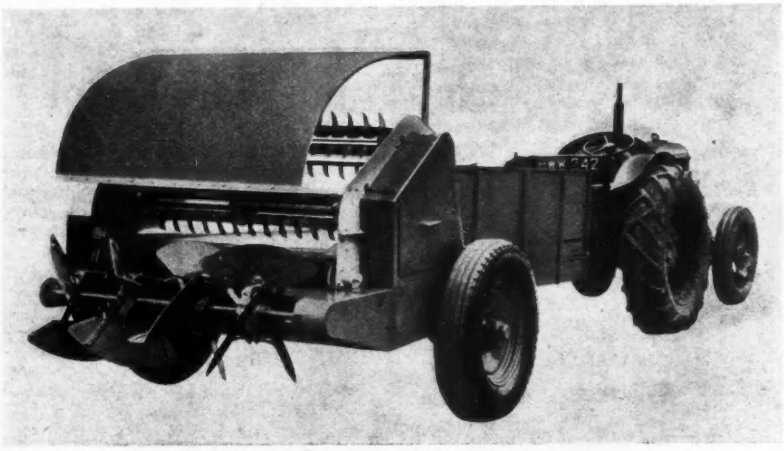
During the post-war years, the shortage of farm labour has been one of the factors leading to the increasing use of hedge-cutting machines. One of the machines of this kind, shown at last week's exhibition, is the "Hedge-Maker," manufactured by Bomford Brothers, Pitchill, near Evesham, and illustrated in one of our engravings. The makers say that this machine has been designed to deal with awkward hedges and certainly its long reach—13ft 6in from the tractor wheels to the tip of the 5ft knife—enables it to deal with hedges across a wide ditch. The machine, which weighs



"TRACKMASTER" DIESEL TRACTOR—DAVID BROWN



"DRAGON" CRAWLER TRACTOR—VIVIAN LOYD



ATKINSON MANURE SPREADER—DAVID BROWN

6½ cwt, is available for convenient mounting on several makes of tractor, in some cases at the rear but, more generally, amidships. It consists essentially of a steel tubular beam with a 2 h.p. Petter oil engine at one end for driving by a belt, the orthodox cutter-bar fitted at the other end. A simple balance adjustment enables the operator to raise or lower the knife with little effort.

HEDGE CUTTER—BOMFORD

Another implement of a somewhat unusual character, which we noticed at Earls Court, is the "Rotoflail," which is about to be put into commercial production by Pest Control, Ltd., Harston, Cambridge. Its purpose is to disintegrate straw—left after combine harvesting—or other unwanted vegetation, to form humus. The resulting broken-up mulch rots quickly and is then easier to plough in. The machine consists of an all-welded channel steel frame, with a removable steel cover, and a rotor shaft mounted in sealed bearings and carrying 108 solid rubber flails. The two wheels are pneumatic tyred. The drive is from the power take-off of a tractor, through a universal power shaft and couplings and is transmitted to the rotor shaft through a reversible gearbox and chain and pinion assembly, all moving parts being suitably protected. The flails can be rotated in either direction at a speed of 700 r.p.m. and the machine can deal with a swath width of 7ft.

As is customary at the Smithfield Show, makers of refrigerating machinery and of meat transport vehicles were well represented. British oil engine manufacturers, also, exhibited units specially suited to various aspects of mechanised farming. Ruston and Hornsby, Ltd., Lincoln, for instance, was showing petrol/paraffin engines of 3 and 4½ b.h.p., as well as single-cylinder and two-cylinder oil engines of higher powers, all of them suitable for driving many kinds of farm implements and machines, or for generating electricity. The principal exhibit on the stand of F. Perkins, Ltd., Peterborough, was the P3 diesel engine, which is a three-cylinder unit, 3·5in bore by 5in stroke. It incorporates the firm's patented combustion system and is rated to develop 32 b.h.p. at 3000 r.p.m., the maximum torque being 88 lb per foot at 1200 r.p.m. This engine, it may be added, has been designed for installation in the Ferguson tractor.

Diesel Electric Trains for Egypt

WE recently took advantage of an opportunity to attend a trial run and inspect the first of a number of five-coach main line diesel-electric trains being built by the English Electric Company, Ltd., for the Egyptian State Railways. These trains have been specially designed to provide luxury travelling facilities between Cairo and Alexandria, and on the route to Luxor. They are intended to cover the 130 miles between Cairo and Alexandria in a scheduled time of two hours ten minutes, including a number of intermediate stops.

When these trains were being considered it was stipulated by the Egyptian Railways Administration that they should be of the lightest possible construction, to give the highest power-to-weight ratio; and that they should have high operating speeds coupled with reliable service in the somewhat dusty atmosphere which prevails in the districts in which they were required to work. It was also considered desirable that there should be a high degree of interchangeability in respect to the engine and other parts common to the new rolling stock and to the locomotives already supplied to Egypt by the company. With these requirements in mind the company designed the trains and received an order for nineteen five-coach articulated trains and eleven three-coach trains for suburban services. The three-coach trains will consist of three articulated units similar in all respects to the five-coach trains except that they will have one instead of two power units.

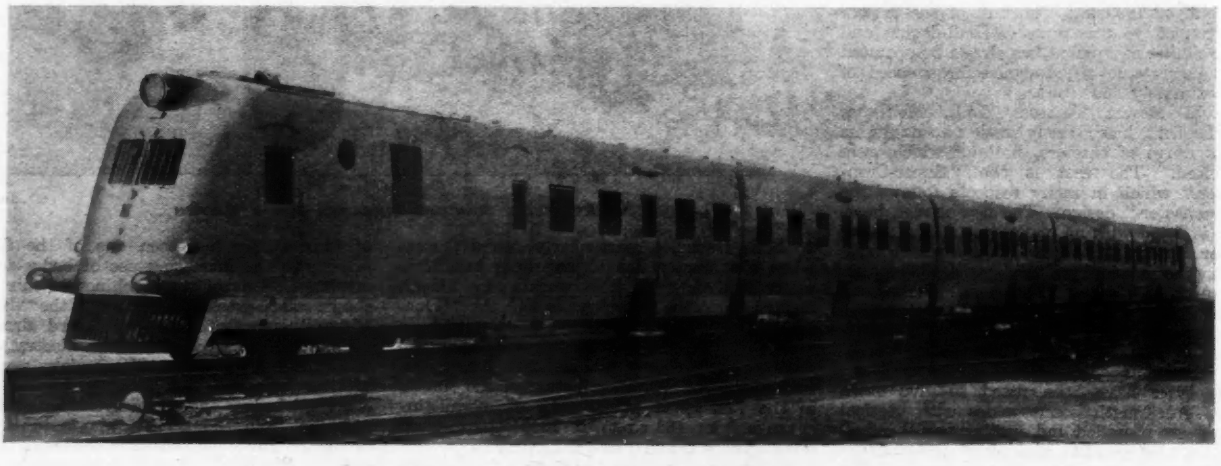
The first of the new trains, which has completed its trials and is about to be shipped to Egypt, is shown in the illustration on this page. Its five coaches provide seating accommodation for sixty first-class and 112 second-class passengers, and a well appointed buffet in the centre of the train has cooking and refrigerating equipment installed. The first-class coaches are fully air-conditioned.

In these five-coach units, which are 255ft 3in long overall and weigh 149 tons 9 cwt, fully laden, power is supplied by two 400 h.p. diesel-electric generating units, one at each end of a train. The power from each engine is transmitted to two traction motors on the motor bogie situated under the articulated joint between the first and second coaches. The trains are designed for a maximum service speed of 75 m.p.h. and an initial acceleration of about 1 mile per hour per second.

In the table which follows are given some of the leading particulars of the new train.

Track gauge	4ft 8½in
Overall length of five-coach train	255ft 3in over headstocks
Overall width	9ft 6in
Overall height	12ft 6½in
Distance between bogie centres ...	46ft 3in
Wheelbase of motor bogies ...	8ft 7in
Diameter of motored wheels ...	40in
Diameter of unmotored wheels ...	34in
Maximum axle loading, express units	15·4 tons
Fuel tank capacity	400 gallons
Diesel engine, cylinders	10in bore by 12in stroke
Diesel engine, rating	400 b.h.p. at 750 r.p.m.
Traction motors	4 self-ventilated
Gear ratio, express units	59/17
Maximum starting tractive effort	18,000 lb
One-hour tractive effort	9,500 lb at 22 m.p.h.
Continuous tractive effort	7,250 lb at 29·5 m.p.h.

The electrical equipment and the engine were designed and built in the English Electric



FIVE-COACH ARTICULATED DIESEL ELECTRIC TRAIN

Company's works at Stafford and Rugby.

The 4 SRKT 400 h.p. engine fitted in the trains is a four-stroke, cold-starting, compression-ignition unit, with four cylinders in line and employing direct mechanical fuel injection. The Buchi system of pressure charging by a blower driven by an exhaust gas turbine is used. Aluminium alloy pistons in the engines have three gas and one oil control ring above the gudgeon-pin and one oil control ring below. Cylinder liners of cast iron are clamped at the top end only to facilitate inspection. To eliminate the vertical unbalanced secondary forces inherent in a four-cylinder engine, a positively driven balanced system is used. Two countershafts with distributed balance weights are geared to the main crankshaft and rotate at twice the engine speed. The upper half of the

DRIVING CAB

crankcase has large inspection doors through which the pistons connector-rods and bearings can be withdrawn if necessary. Separate covers give free access to the camshaft drive.

Bryce fuel injection equipment is fitted and separate injection pumps, mounted in line with each cylinder of the engine and driven from a camshaft, are individually adjustable for injection timing and the quantity of fuel. The engine is governed through the electrical control equipment relating to the field of the generator. A sensitive mechanical governor with hydraulic servo gear operates the fuel control shaft. Engine speed is varied in three steps of idling at 300 r.p.m., 450 and 680 r.p.m., by means of electrically operated solenoids, which vary the loading on the governor. Co-ordination between the solenoids and the variation of the governor field is designed to ensure that the maximum loading imposed on the engine is automatically limited to correspond with available engine output. This arrangement, in addition to avoiding critical speeds, also prevents overloading of the engine and ensures that full engine horsepower can be utilised for a wide range of speed and tractive effort.

A radiator fan is situated in the side of the engine compartment and a fan mounted in the roof draws air in through louvres in the side of the coach and expels it through the top. Dust is removed from the air being drawn into the engine compartment by air filters fitted with removable felt pads.

The engine and the generator are rigidly coupled together to form a single unit, which is supported at three points only. This arrangement makes the power unit independent of the warping and twisting stresses which are inevitable in traction work and which might otherwise upset the alignment of the engine and generator.

The self-ventilated, single-bearing generators coupled to the engines are of the direct winding type and have a separately excited field winding, a decompounding series winding, and a further series winding, which is only used when the generator is motored from the batteries for starting the engine. Each generator supplies power to two series wound reversible traction motors. The generator compartment, which also houses the control equipment, is sealed off from the external atmosphere to prevent dust penetrating into the mechanism. Electro-pneumatic relays are housed in sheet steel cubicles fitted with large doors to permit easy access. An exciter mounted on a shaft extension of the main generator, in addition to supplying direct current to the main generator field, provides power for a compressor motor, charging the batteries and operating the control equipment.

The driving cabs at each end of the train are roomy and well arranged. The driver sits in the centre of the cab and large windows give him an excellent view of the line. He has a neat control switch panel in front of him and all the main driving control gear is arranged close to hand. A 14-inch searchlight at roof level gives a powerful forward beam of light at night. In each cab is a master switch, a reverser control and a main controller, from which complete operation of the train, including control of both engines, is available. When the master switch is moved to the "start" position the electrically-driven lubricating oil priming pump, which is energised from the battery, starts up. When the oil pressure has built up to a safe value a pressure switch in the oil circuit closes and completes the circuit to the batteries. The generator then motors and starts the engine. Should the battery be too low to start the engine an emergency start switch can be operated and the train can be pushed a few yards by another locomotive. The traction motors then act as generators and supply current to the main generator, which turns the engine.

The master switch can be set in an "engine only" position if it is desired to run the engines alone for warming-up or testing purposes. With the switch in this position the controller can be moved to speed the engines but no power is supplied to the traction motors. When the master switch is placed in the "off" position the fuel supply to the engine is cut off and it stops. If the air pressure for the braking system or the oil pressure of the engine lubricating oil circuit falls below a safe value, auxiliary circuits cut off the power to the motors and the train is automatically brought to a stop. A deadman's safety device is fitted on the main controller to provide an additional safeguard against accidents. This device is controlled by a pedal in front of the driver's seat and the pedal must be kept depressed whilst the train is running.

Westinghouse compressed air braking is fitted throughout the train and mechanical hand brakes, which work on the power car bogie wheels only, are also provided.

The all-metal coaches of the train are designed integrally with the underframe and are carried on fabricated bogies. The underframes of the power coaches are made up from fabricated, rolled steel sections and plates, whilst those of the passenger coaches are of lattice girder construction. All the framing members are of cold pressed steel section and the main pillars, of flanged "U" section, are carried from the underframes by flanged plate outriggers and further reinforced by gussets. The steel sheeting, which forms the outer panelling of the coaches, is attached to the frame members by a combination of arc and spot welding and riveting.

Solid rolled steel disc wheels are pressed on to the axles and the journals are fitted with tapered roller bearings, carried in cast steel housings. Long laminated overhung axlebox springs are fitted and adjustable spring hangers have auxiliary coil springs. Coil-type body suspension springs are carefully proportioned to work in conjunction with the axlebox suspension to give smooth, even riding of the coaches.

The floors of the coaches are of tongued and grooved boards bolted to the underframe, covered with a quarter-inch thickness of "Insulwood" and overlaid by heavy linoleum. The interiors of the first-class coaches are panelled in "Sundeala" and finished in high-grade enamel. Seats in the first-class compartment are upholstered in moquette or hide, the seat frames being of steel and timber and the cushions of "Dunlopillo." In the second-class compartments fixed seats have angle-iron and tubing frames upholstered with spring-filled cushions covered with rexine. Full air conditioning is provided in the first-class compartments, the air being supplied by sets driven by 90 h.p. oil engines in each engine cab and cooled to the required temperature by refrigerator units. All windows in these first-class compartments are fixed, whilst those in the second-class compartments are of the half-lift type.

During the trial run which we attended the train attained a maximum speed of about 77 miles an hour and at this and all other speeds the riding was very comfortable.

Side Tank Locomotives for Tanganyika

Two 2–6–2 type side-tank locomotives for the East African Railways and Harbours, Tanganyika Section, have recently been completed by W. G. Bagnall, Ltd., at Castle Engine Works, Stafford. The locomotives have been built to the requirements of the chief mechanical engineer of the railways and under the supervision and inspection of the Crown Agents for the Colonies.

These locomotives are generally similar to the standard shunting engines, which have previously been supplied to Tanganyika, but a number of improvements have been incorporated and a degree of standardisation of parts with other locomotives recently supplied has been carried out.

The principal dimensions of each locomotive are as follows:—

Cylinders (two) diameter	16in by 22in stroke
Wheels (coupled)	3ft 7in diameter
Leading and trailing truck wheels (diameter)	2ft 4½in
Rigid wheelbase	11ft 6in
Total wheelbase	26ft 6in
Boiler heating surface (small tubes) (107)	469 square feet
Superheater tubes (18)	237 square feet
Firebox	100 square feet
Total evaporative heating surface	806 square feet
Superheater surface	181 square feet
Working pressure	180 lb per square inch
Grate area	12·75 square feet
Tractive effort at 85 per cent of boiler pressure	20,040 lb
Water capacity of tanks	1,500 gallons
Bunker capacity—coal	3 tons

The boiler has two barrel rings, and the narrow Belpaire firebox is fitted between the frames. The inside firebox is made of copper ½in thick, the roof is stayed by steel direct stays with four rows of sling stays at the front to allow for expansion.

The cylinders have 8in diameter piston valves and Walschaerts valve gear is fitted. The reversing gear is lever operated. A ten feed No. 7 Wakefield mechanical lubricator is fitted, six feeds being arranged to the axleboxes, and the remainder to the slidebars. A sight feed lubricator is also provided with feeds arranged to the cylinder barrel and steam pipe.

The locomotive frames are of steel plates 1in thick, with pressed steel stays, and the cast steel axlebox guides are fitted with adjusting wedges. Laminated bearing springs are underslung and not compensated. The fully compensated brake gear is vacuum operated by two 21in cylinders arranged outside the frame, behind the footstep.

The swing link front truck is fitted with Timken roller bearings and the hind truck has a Timken Cannon axlebox.

The locomotives are provided with M.C.A. couplers but arrangements have been made so that, when the conversion of this railway to 3ft 6in gauge is carried out, M.C.B. couplers can be fitted. With the possible future conversion in view the wheel centres have been designed so that new tyres can be fixed in the 3ft 6in gauge position by reducing the diameter of the wheel centres and increasing the tyre thickness ½in.

THE ENGINEER

DECEMBER 15, 1950

VOL. CXC No. 4951

Contents

THE ENGINEER, December 15, 1950 PAGE

LEADING ARTICLES—
ANNUAL REPORT ON ELECTRICITY SUPPLY 594
FOREMAN AND LABOUR TURNOVER 594

SPECIAL ARTICLES—
DEVELOPMENT OF THE RIVER RHONE. No. II. (Illus.) 580
ESQUIMALT AND NANAIMO RAILWAY. No. VI. (Illus.) 584
AGRICULTURAL MACHINERY EXHIBITION AT EARLS COURT. No. II. (Illus.) 590
AUTOMATIC GAS PILOT CONTROL DEVICE. (Illus.) ... 605
DIESEL-ELECTRIC TRAINS FOR EGYPT. (Illus.)... ... 592
DIESEL ENGINE POWER PACK. (Illus.) 604
DISCREPANCIES BETWEEN THE CALCULATED AND MEASURED WAVEMAKING OF HULL FORMS ... 603
ELIMINATING PRECIPITATION FROM COOLING TOWERS (Illus.) 589
ESCAPE EQUIPMENT ON HIGH-SPEED AIRCRAFT. (Illus.) 599
GIRDER CLIP. (Illus.) 603
GRAPHITE LOW ENERGY EXPERIMENTAL PILE (GLEEP) (Illus.) 587
HEAVY-OIL ENGINE WORKING COSTS 601
IMPROVED PORTABLE POWER SAW. (Illus.) 603
INSTITUTE OF METALS APPEAL FOR FINANCIAL SUPPORT 602
LOCOMOTIVE UNLOADING GANTRY. (Illus.) 597
MARINE REDUCTION GEAR. (Illus.) 604
PRECISION GUILLOTINE SHEARING MACHINES. (Illus.) 600
PRODUCTIVITY TEAM'S REPORT ON DIESEL LOCOMOTIVES 603
RESULTS OF DOUBLE DECK TRAIN TRIALS 601
SIDE TANK LOCOMOTIVES FOR TANGANYIKA 593
SIR ERIC YOUNG'S RESIGNATION FROM THE COAL BOARD 596

LETTERS TO THE EDITOR—
MOTOR SHOW 596
SCIENCE AND THE ENGINEER... 596

LITERATURE 595
SHORT NOTICES 596

A SEVEN-DAY JOURNAL 579
BRITISH STEEL FOUNDERS ASSOCIATION
COKE OVEN PLANT AT EAST GREENWICH GASWORKS
IMPERIAL COLLEGE VACATION WORK SCHEME
LAUNCH OF THE "BRITISH ADVENTURE"
PORT OF LONDON AUTHORITY REPORT
REPORT OF THE FUEL RESEARCH BOARD

NEWS AND NOTES—
AMERICAN ENGINEERING NEWS. (Illus.) 605
BRITISH PATENT SPECIFICATIONS. (Illus.) 609
BRITISH STANDARDS INSTITUTION 610
CATALOGUES 608
CONTRACTS 608
FORTHCOMING ENGAGEMENTS 610
FRENCH ENGINEERING NEWS 606
INDUSTRIAL AND LABOUR NOTES 607
LAUNCHES AND TRIAL TRIPS... 610
NOTES AND MEMORANDA 608
PERSONAL AND BUSINESS 608
SOUTH AFRICAN ENGINEERING NOTES... 602

NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

For Subscription Rates, see page 2 of Advertisements.

ELECTRICITY SUPPLY

THE second annual report of the British Electricity Authority, which was briefly referred to in our issue last week (page 556), contains a good deal of encouraging information to relieve an otherwise gloomy picture, painted of an industry seriously hampered by a shortage of generating plant. It is reassuring, for instance, to learn that, despite the difficulties of developing supplies in sparsely populated areas, good progress has been made with rural electrification. It is no reflection on the work of the Area Electricity Boards to point out that the rapid growth in rural electrification is, to a large extent, an expression of the size of the unsatisfied demand for electricity in rural areas. The number of farms receiving supplies increased during the year by 7·5 per cent and the number of units sold to them increased by 19·6 per cent, whereas, over the same period, domestic consumption rose by only 1·9 per cent. Turning to the operational side of the supply industry, it is equally encouraging to learn that the overall average thermal efficiency increased from 21·15 to 21·33 per cent in the year under review, due, partly to the high efficiency of newly commissioned plant, partly to improvements in the distribution of fuel supplies and, partly, to the optimum practicable loading of generating plant. Yet another welcome sign was the continued fall in the average loss of generating capacity because of breakdown and other causes. The total "outage" measured in January fell from 12·1 per cent in 1949 to 11·4 per cent in 1950, compared with 16·3 per cent in 1946 and 14·8 per cent in 1947.

But these and other satisfactory trends are, unfortunately, overshadowed by the shortage of generating capacity. The report makes no attempt to hide what it itself calls the gravity of the generating situation. Last winter the difference between the available plant capacity and the highest potential demand for electricity was estimated to be 1518MW sent out and it would have been in the region of 2140MW but for the relief gained by load spreading arrangements and the happy chance of unusually mild weather. It is worth noting that the potential deficit, thus revealed was no less than one-sixth of the total available capacity! Similarly, the report estimates that at currently planned rates of increasing capacity the prospective plant deficiency in the absence of load spreading will be 1889MW in 1950–51, and will still be as high as 1702MW in 1952–53. Accordingly, the Authority considers that it will be many years on the present expectation of growth in demand before full supplies can be given at all times "... unless the annual programmes of new generating plant can be rapidly increased from the present level of 1000MW to at least 1800MW sent out." Progressively larger annual programmes, up to 1800MW in 1956–58, have, therefore, been prepared by the Authority in conjunction with the manufacturers of turbo alternators and boiler plant. The Authority realises that these programmes will require "a supreme effort on the part of all concerned," but considers that they are physically attainable, although they may have to be modified in the light of national requirements.

To appreciate the magnitude of the task, it is as well to compare the proposed expansion with past achievement. The plant actually commissioned in successive calendar years, starting with 1946, was 307MW, 340MW, 566MW and 703MW, while in the current year strenuous efforts are being made to commission a total of 1000MW. What, then, are the prospects of reaching an annual rate of 1800MW in six or seven years' time? In what ways can time in construction and installation be saved? In that connection, and bearing in mind the difficulty of finding suitable sites for new power stations, we have much sympathy for the claim that a more realistic approach should be made to the problem of obtaining consents for the necessary developments. It is, of course, desirable that every interest involved should have the opportunity to state a case against any particular development. But need the grant of that elementary right necessarily lead to the protracted delays which in the past have added twelve months and sometimes more to the time required for commissioning new stations? Then, at the design stage, standardisation offers prospects of time saving during the later stages of construction. As an example of what can be done, the report mentions the adoption of the same lay-out and general design at two new power stations—Bold (St. Helens) and Roosecote (Barrow). The same set of drawings is to be used for the superstructure of the main buildings and plant, while additional drawings, to suit the individual sites, will be used for the substructures of the main buildings and the auxiliary plant. But how considerable such savings of time and, perhaps, of cost, will prove to be is still open to doubt. As a discussion recently held at the Institution of Mechanical Engineers revealed, opinion amongst, at least, manufacturers of plant, is by no means unanimous about the advantages of standardisation upon either ground. It is possible, too, that standardisation, if it is to be as effective, as its protagonists hope, will have to be carried further. For the 30MW and 60MW sets, subjects of the recent standardisation, seem likely very soon to prove uneconomically small. Plant programmes of the magnitude now envisaged will hardly be feasible unless these smaller standard sizes give place to units of 100MW or 120 MW (as suggested in the report on Electricity Supply of the Anglo-American Council on Productivity) with the aim of reducing, eventually, the manufacturing and installation time per kilowatt of plant. For the rest, there is no reason to suppose that the new programmes will confront the contractors with any insuperable problems provided that their task is accorded the necessary priority in materials and manpower and provided that the manufacturers, in particular, are given the necessary assurances regarding their long-term commitments. But those provisos are big ones dependent upon the changing economic situation of the country and the opinions and even perhaps the "colour" of the Government. How much priority should be given to manufacture and installation of generating plant (and the equally important transmission and distribution equipment) and how much to coal raising plant, transport, housing, health, &c., is unfortunately difficult to calculate without political considerations creeping in. Nor are the calculations wholly unaffected by world events, like the war in Korea.

THE FOREMAN AND LABOUR TURNOVER

So much has been written about the position of the foreman in industry, his status in the factory, and the effect of functional organisation on his supervision, that it is with a degree of hesitancy that we return to the consideration of the individual who has been likened to one in the precarious position between the upper and nether millstones of industry. There is, however, one aspect that has not been given the attention it undoubtedly deserves, and that is the part he plays in the labour turnover of the organisation in which he finds himself. Whether he is regarded as taking his place on the side of the worker or on that of management, it is essential it should be

fully realised that in the workshop he is regarded as management itself. The subject of labour turnover is one of paramount importance and our notice has been directed to the foreman's role in this matter by an interesting little brochure we recently received, published by the Institute of Industrial Supervisors. Most managing directors are alive to the fact that excessive labour turnover is a drain on efficiency but it is one of those insidious factors the full incidence of which is not at all readily determined, and for this very reason it often escapes the investigation it warrants. Mr. N. V. Terry, the author of the booklet before us, has evidently made a study of a subject which all engineers would do well to consider.

Having realised the importance of the problem the first step to be taken is to endeavour to determine exactly what the labour turnover actually is in a given period, the simplest way being to express the number of men or women who leave a firm's employment as a percentage of those employed in the same period of time. Admittedly, this ratio may give a somewhat exaggerated result in that some posts may be vacated and filled more than once during the specified time, but for the sake of comparison that objection is of little moment. When we are informed that the total labour turnover in eight typical Midland factories is as high as 37·2 per cent, the desirability of a close scrutiny is emphasised. In speaking of the insidious nature of labour turnover we had in mind the great difficulty of exactly ascertaining its cost to the administration, but it will readily be appreciated that in the personnel department alone much time must be spent in both the discharge of an employee and the taking on of a replacement. A new employee does not readily assume his duties, he needs initiating into them, and the practice of letting him "pick it up" from others is probably as expensive as it is unreliable, whereas the foreman can do much to make a man at home both in his work and in his environment. If the new entrant has to join a group of workers the change has without doubt a prejudicial effect on the output of the whole group. The foreman is a busy man, who is always being urged to increase production, and he may feel that the hours devoted to the training of a new entrant represent so much wasted time, whereas he should realise that on balance, by making the individual concerned happy and efficient, he is reducing his own subsequent worries and helping to avoid a further change in personnel. Labour turnover may readily be divided into two classes: the avoidable and the unavoidable, and it is naturally the former to which attention should be directed. A man may desire to change his employment for a variety of reasons, such as not liking his work or because his employer indicates that he is not suited to his duties, or he may be in a group and yet sadly lacking "team spirit" and accordingly uncomfortable, or he may always be in hot water due to indifferent timekeeping, or he may be at variance with his foreman. To present the picture to a foreman in an arresting and convincing manner we suggest that statements of labour turnover for each workshop should be circulated to all supervisors, thereby causing a foreman whose labour turnover is well above that of his fellows "furiously to think."

Having arrived at the conclusion that a foreman is in a position to do much to minimise a recognised evil, the question arises as to how he should set to work. For he should set out to be a sympathetic and intelligent leader rather than a martinet, or, worse still, a bully. He should bear in mind that however careful the personnel department may have been in selecting a new hand, unless he does his part in making the entrant feel at home in circumstances that are strange to him, an initial good impression will be speedily dissipated. By taking a genuine interest in those entrusted to his charge, by encouraging them to discuss their home affairs and hobbies, by explaining to them in a general way the company's policy, by indicating the nature of work on which the firm is engaged and some of the problems ahead, and by persuading them to take a live interest in the social activities of the organisation, he can endeavour to inculcate a spirit of loyalty, which will do more than anything else towards the reduction of labour turnover. By the foreman following up the careers of those who have left, particularly those regarded as "veterans," the present workpeople learn to think of themselves not as mere cogs in a soulless machine, but rather as members of a big family, and it is in these healthy and happy conditions that men delight to make a boast of having been fifty, sixty or even more years with the same company. Should a slump arise the foreman will endeavour to find alternative work for his men, while should he reluctantly have to reduce numbers, he will keep in touch with those discharged with a view to their re-engagement at the earliest possible moment. We have not touched on financial inducement, but it is obvious that unless pay conditions are attractive, men will soon seek employment elsewhere.

Literature

West Highland Steamers. By C. L. D. Duckworth, B.Sc., M.I.C.E., and G. E. Langmuir, M.A., LL.B. London: Richard Tilling. 1950. Price 15s. net.

Although claiming to be a second edition of the useful and informative book that appeared fifteen years ago, actually the one now before us is virtually a new book, being entirely rewritten with a large amount of valuable information added, as well as a complete record of what has transpired during the interval that has elapsed. Although the authors modestly state that "a volume of this nature involves little or no creative work," the amount of research and sifting of ancient records, some of distinctly doubtful reliability, must have been a formidable task and the authors are to be congratulated on giving us so much informative matter in the compass their disposal, while the fleet lists, occupying over thirty pages at the end of the book and giving the leading dimensions and particulars of the ships employed since the beginning of steam navigation, are a valuable addition to a valuable book. Incidentally, it would be improved if the tables were lined vertically as well as horizontally. A large number of good illustrations greatly enhance its interest.

The first chapter deals with what transpired in steam navigation between the years 1812 and 1850, and the seven succeeding chapters describe the different companies that have operated one after another, showing how the numbers have been reduced by elimination and absorption until at the present time practically all the services are in the hands of David MacBrayne, Ltd., the last absorption being the old-established shipping company of McCallum, Orme and Co., Ltd., which was acquired in 1947.

In our review of the first edition mention was made of the interest of the then fleet to engineers, in that it was a veritable museum containing every type of vessel, with the notable exception of the turbine steamer. This omission has now been made good by the acquisition of two turbine steamers, one of which was one of the earliest triple-screw, direct-drive steamers, "Queen Alexandra," which was considerably modified and as "Saint Columba" has the distinction of being the only three-funnelled ship employed on short sea voyages; with her two masts she is now a craft of exceptionally pleasing appearance. The other turbine steamer, "King George V," was the first steamer of its class to have high-pressure boilers, which worked at a pressure of 550 lb per square inch, with a steam temperature of 750 deg. Fah. The twin screws are driven by single-reduction geared turbines. In 1935 the vessel was given an ordinary double-ended Scotch boiler, working at 200 lb per square inch pressure. If the "museum" has been enriched by these additions a serious loss has been incurred by the fact that there is now no representative of the once universal paddle boat, a type that would appear to be still eminently suited to some of the services in West Highland waters. The authors deplore the passing of these handsome veterans, and it would be hard to estimate the number of engineers who have enjoyed a spell of watching in the engine-room the slow-moving reciprocating engines or, going back to earlier days, the fascination of the huge oscillating cylinders of such craft as the famous old "Iona." But over all this must now be written Ichabod.

The authors have been consistent in dealing with ships in the order of their acquisition by the different companies, a method which makes reference more easy. It would appear from a careful perusal of this book that, not only are the days of the paddle steamer over, but that the days of the steamer itself as far as these northern waters are concerned are numbered, for in the past decades the only steamers added to the fleet have been those taken from other owners, whereas all the new tonnage specifically built for these services has been screw motor vessels, the first venture into the realms of internal combustion machinery having been made as long ago as 1907, when the little "Comet," a vessel of but 43 tons gross, appeared on the scene and soon became familiarly known as the "Lochgoil Mail Steamer." As she operated in Scottish waters for forty years, she evidently paid her way.

The authors clearly point out some of the difficulties incident to providing facilities to the sparsely populated districts served, where tourist traffic is restricted to a very short period of the year and where "hundreds of small consignments of goods have to be handled at dozens of places, at many of which a deep-draught vessel could not call," and these services have to be maintained during the whole of the year. When the present company was formed in 1928 on

"other body or individual was prepared to step into the breach if Messrs. MacBrayne withdrew." This speaks for itself.

While engineers would probably desire more information as to the machinery of the many vessels described, it is realised that in a book of such a comprehensive character much has to be excluded, but sufficient will be found to visualise clearly the different ships and to make possible an effective comparison between them. From the historical standpoint this book is invaluable, and most ship lovers and marine engineers will welcome it as a necessary addition to their libraries.

SHORT NOTICES

Inventions Patents and Monopoly. By P. Meinhardt. Second edition. London: Stevens and Sons, Ltd., 119, Chancery Lane, W.C.2. Price 30s. net.—This book was first published in 1946, and the new edition has been revised and brought up to date to January, 1950. It contains the numerous and important changes in the law introduced in the Patent Acts, 1949; the Monopolies and Restrictive Practices (Inquiry and Control) Act, 1948; and the Development of Inventions Act, 1948. It is as yet too early to assess the precise effect which the provisions of the new Patents Act will have in practice, and in this book the scope of the new provisions are discussed, together with the effect they are likely to have.

Metallurgical Applications of the Electron Microscope. Institute of Metals' Monograph and Report Series, No. 8. London: The Institute of Metals, 1950. Price 21s.—This volume contains the papers presented at the symposium held at the Royal Institution on November 16, 1949, and a full report of the discussion. A summary of the proceedings appeared in THE ENGINEER of November 25, 1949. The full report, in book form, of this very successful symposium, which included contributions from France, Germany and the U.S.A., will be of interest to all who wish to be kept informed of the improvements in technique of electron microscopy and of the new information it provides about the microstructure of metals at very high magnification.

Sir Eric Young's Resignation from the Coal Board

AT the end of last week it was announced that Sir Eric Young had resigned from the National Coal Board. The information was given by the publication of correspondence between Sir Eric and the Minister of Fuel and Power, although that correspondence contained no explicit reasons for Sir Eric's decision. Early this week, however, further statements were made by the Minister and Sir Eric, the latter saying that in order to exclude any possible misunderstanding he felt it his duty to make public the reasons for his resignation. Sir Eric's statement went on to explain that he had long been dissatisfied with the structure of the Board and the manner in which it was operating. His firm conviction was that while it continued on the existing Civil Service lines, it could never produce the quantity of coal, and at prices, which the national interest demanded. Sir Eric said that he had more than once thought of resigning, but had hoped that by remaining he might help to bring about necessary changes. That hope, however, had steadily diminished and, with it, his own prospect of useful service.

BOOKS RECEIVED

The Patents Act (1949). London: Sweet and Maxwell, Ltd., 2 and 3, Chancery Lane, W.C.2. Price 37s. 6d.

Automobile Electrical Equipment. Fourth edition. By A. P. Young, O.B.E., M.I.E.E., M.I.Mech.E., and L. Griffiths. London: Iliffe and Sons, Ltd., Dorset House, Stamford Street, S.E.1. Price 25s.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE SCIENTIST AND THE ENGINEER

SIR,—The correspondence in your columns (W. L. Cowley, September 22nd and F. R. Wilson, November 17th) under the above heading, will have caused some interest in circles outside those of pure science and engineering: the references to religion and astrology indicate this.

The issues raised are, I suggest, clear enough, although Mr. Cowley tends to obscure them somewhat in his desire to question a subsidiary point, which he has raised before, namely, the validity of the postulates underlying the "associated jargon" of the quantum theory.

Let us first agree with Mr. F. R. Wilson that the scientist is concerned to investigate nature: but his investigation is confined to those aspects of truth and reality which are capable of mathematical expression and the "jargon" to which Mr. Cowley objects is merely the currently accepted mathematical mode of expression. The only sanctions for operations currently used are that, for practical purposes, they work; but it might be difficult to find a scientist who is prepared to assert dogmatically that the macrocosm, in its ultimate reality differs from the microcosm. All that one is entitled to infer is that "in our present state of knowledge" we obtain worthwhile results of meaning and utility to the engineer if we use mathematical operations which postulate a reality different for the macrocosm than for the microcosm: that is all.

This broad issue can be better understood if one reflects on the history of the subject. Before the days of the space-time continuum a rash scientist might have argued that the ultimate nature of the Universe was pretty well known; it was mechanistic and subject to the laws of Newtonian physics. Many scientists did indeed make this assertion and from this it followed that there was no scientific justification for talking, in the words of Mr. Wilson, of "a great system of justice and eternal truth." The theories of Einstein and the work of atomic physicists have smashed the Newtonian Universe and we now find ourselves with a paradox—namely, that arising when scientists appear to be telling us that the Universe viewed from one aspect (the macrocosm) is a fundamentally different Universe when viewed from another aspect (the microcosm).

The answer to the dilemma, however, is to understand that the scientists are telling us nothing at all about the ultimate nature of the Universe; they are framing hypotheses about certain aspects of the Universe and those hypotheses are just as likely to be superseded in time as were those of Ptolemy and Newton. If we seek to infer from these hypotheses that the Universe is "this" or "that," we are open to the same objections as confronted the nineteenth-century mechanists and it is almost certain that in due time we shall find ourselves forced to eat our own words.

Thus, when Mr. Cowley says that scientists tell us that the "microscopic differs logically from the macroscopic" he is, with due respect, saying too much. All the scientists tell us is that they consider that more worthwhile results are obtained *if the human mind uses different logics*; but that is not to say anything about the things themselves. Hegel, the philosopher, adopted the same technique and made the same error; he argued that if Aristotelian logic were abandoned and another used in its place different results were obtainable; his error was to assume that those results constituted the last word on reality itself. Logical-positivists to-day are wandering in the same wasteland. We must clearly distinguish between what things are in themselves and what we make of them.

On two points, however, I must agree with your correspondents. Mr. Cowley appears to dislike a Universe which, in the light of current knowledge, appears to be contradictory: we can sympathise with him and in arguing for greater simplicity and unification he is following a sound tradition. If he can reformulate the mathematics of the microcosm and show how his reformulation is more in accord with empirically verifiable data than current theories and jargon he will have rendered a great and tremendous service; but the onus is on him.

Secondly, Mr. Wilson, in drawing attention to the need to understand what lies behind pure "operationalism," has struck a good blow for sounder general education and if his advice were followed there would be less confusion in many scientific and technical minds of the future about matters which, in essence, are philosophical.

C. G. SMITH

Egham, Surrey, November 27th.

THE MOTOR SHOW

SIR,—The writer of your report upon the Motor Exhibition "notes with satisfaction ... that the public has now accepted the 'new look' of 1948 without reservations." Surely he is making a facile assumption and has taken far too much for granted.

The fact that the public has—more or less—accepted the "new look" by no means indicates that the ugly modern styles are appreciated. What degree of choice has the public? Two dominant factors now govern the selection of a car—availability and price. The desirability of any particular body style is far outweighed by these two factors. Only if sales of cars in the hideous modern styles exceeded those of more orthodox appearance under conditions in which both types were freely available at competitive prices, would it be true to say that the "new look" designs had been accepted.

It has been truly said that beauty is in the eye of the beholder, and it may be that a section of the public views favourably the hideous cars now to be seen on the roads. In my opinion the introduction of a radiator grille which resembles a giant mouth-organ, or is almost completely suppressed by a bonnet which is like an inverted receding chin, are regrettable steps which have been taken largely because designers and manufacturers consider it essential to ape the Americans.

That modern cars can combine improved interior width and a "one-piece" appearance with really pleasing lines is obvious. The Les Francis, Triumph, Riley and Jaguar—to name but a few—are examples.

Car designers, as a class, seem to be very much like women in some respects. They must be in the fashion no matter how ugly the fashion of the moment may be.

Fortunately, dies for body pressings have only a limited life, and when those now in use have had their day styles may change again, possibly for the better—they could hardly be worse in some cases.

Can your Show reporter cite any vehicle fitted with a live rear axle? The only vehicles now running with live rear axles are old Foden and Sentinel steam wagons. I doubt if a single car with a live rear axle has been produced since the original chain-driven "Trojan."

E. B. PARKER

Wirral, Cheshire, December 8th.

A Locomotive Unloading Gantry

A RECENT order for 100 locomotives for the Victoria State Railways, Australia, gave rise to an interesting unloading problem. The locomotives have been built by the North British Locomotive Company, and were shipped from Glasgow to Melbourne. Although they could be loaded by heavy crane on to the decks of vessels at Glasgow, it was learned that no crane of sufficient capacity was available in Melbourne to unload them.

The provision of a standard 100-ton crane was definitely ruled out by the time available before delivery and the use of shear legs was also impracticable, since the harbour authority required that any lifting structure should be capable of being moved away from the unloading point. The choice therefore fell upon some sort of mobile lifting appliance with a maximum capacity of 100 tons, and the gantry, which is the subject of this article, was developed.

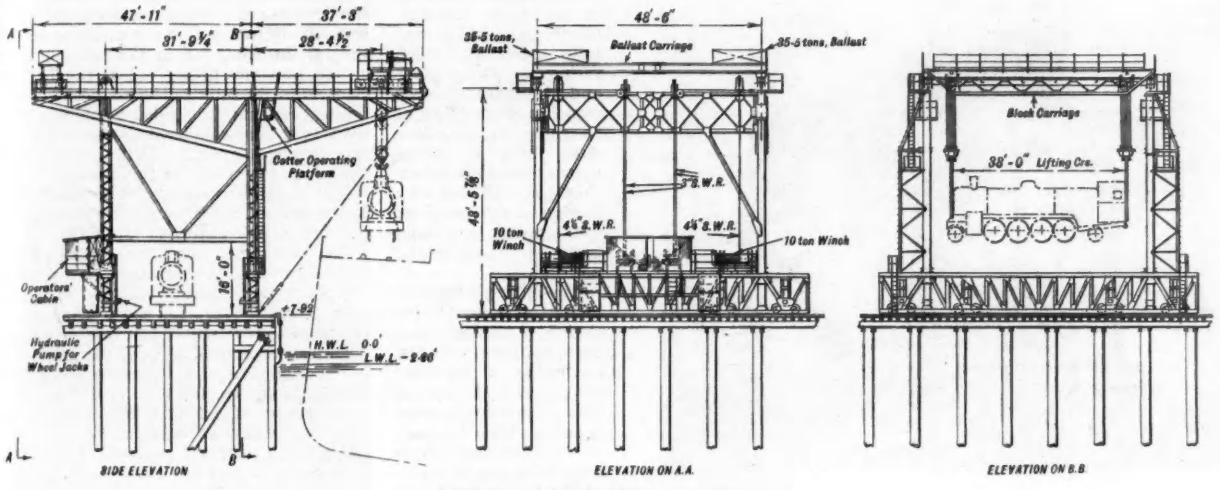
This gantry consists essentially of two spreader girders, supported on the deck of the pier, each carrying two lattice columns; the columns carry two transverse lattice girders, on which the block carriage and ballast carriage move. The lattice girders are arranged with cantilever ends, which overhang the pier and allow the block carriage to be brought over a ship's deck to lift a locomotive. The design allowed rapid erection and incorporated two standard 10-ton ships' electric winches for providing lifting power.

The conditions governing the design of this gantry were unusual in many ways. Its cost had to be covered by the freight charge for the shipment of the 100 locomotives. In fact, transport by a special vessel equipped with locomotive lifting gear proved to be slightly cheaper, but was not adopted because it would have involved delivery at a later date. The locos were carried as deck cargo by the joint regular service of the Alfred Holt and Shaw Savill Lines, and could thus be shipped individually almost as soon as they were completed. Apart from cost, the main requirement was that the gantry should be ready for use in Melbourne by May of this year.

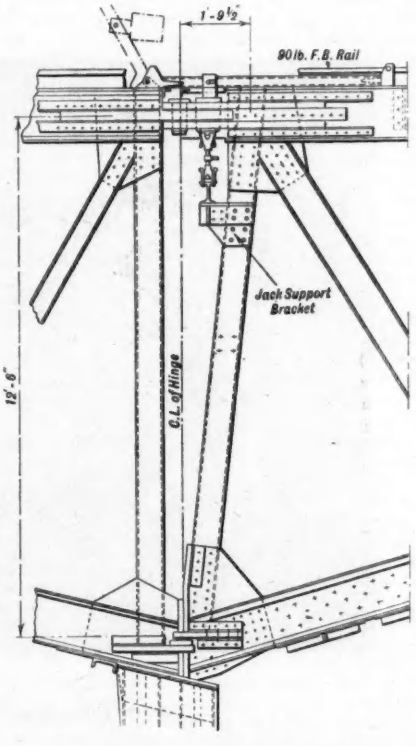
The consulting engineers, Sir Bruce White, Wolfe Barry and Partners, were first approached in the middle of July, 1949. A preliminary report was submitted in August and forwarded to the Melbourne Harbour Trust for its consideration and, if acceptable, its agreement to the installation and use of such equipment on one of the berths in the harbour. Early in September, 1949, it was learned that the Trustees were willing to give general approval to the scheme, and that the equipment could be erected on the Nelson Pier, provided certain conditions were complied with.

To accord with the locomotive building programme, all parts of the gantry were required to be manufactured and available for erection and testing in this country by February 1, 1950, a matter of twenty-one weeks. One month was to be allotted to erection and testing, after which the gantry was to be dismantled and shipped by the middle of March to be ready for erection in Melbourne before the arrival of the first locomotives. Owing to the shortage of time, and as the gantry was of original conception and design, it was essential to depart from the normal practice, whereby one manufacturer undertakes the design and construction of the equipment. A procedure very similar to the methods employed in the last war, when time was of such importance, was therefore adopted.

Following receipt of the drawings of the pier, the work of designing was taken in hand by the consulting engineers in September and detailed working drawings were available towards the end of October. In addition to designing the gantry the consulting engineers had also to make all the working drawings for the structure, as also for the mechanical and electrical parts, many of which were of a complicated nature. With the working drawings available at the end of October there remained three months for manufacture and it was found that, owing to heavy commitments, no firm could undertake the complete manufacture. It is satisfactory to relate that a number of Glasgow firms, including Alexander Findlay and Co., William Bain and Co., and the Clyde Crane and Engineering Company, were induced to manufacture the various structural and mechanical parts, which were all delivered by February 1st to the works of Sir William Arrol and Co., Ltd., for erection and testing.



GENERAL ARRANGEMENT OF GANTRY



DETAIL OF CANTILEVER HINGE

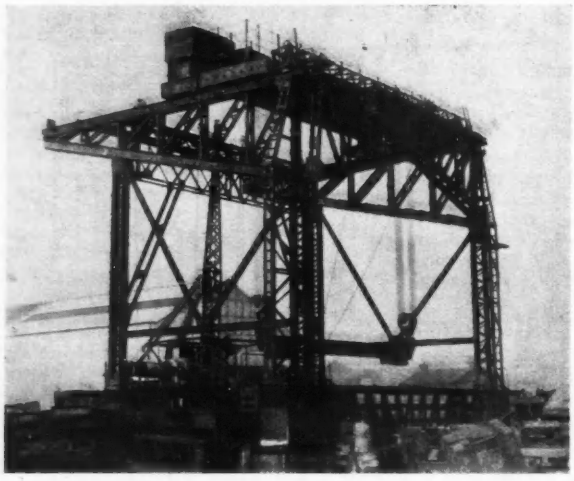
Design of Gantry

The Nelson Pier, on which the gantry was to be erected, had been designed to take rail tracks suitable for 100-ton locomotives, the piles and decking of the pier being of timber construction. Since it was essential that the gantry should be used on the pier as it stood, without strengthening of any description, the base of the gantry resolved itself into two spreader girders. These girders bear on the wooden transomes of the deck of the pier by means of folding wedges when the gantry is in use, and are jacked up to allow it to be moved away.

The general arrangement of the gantry is shown in the illustration above, from which it may be seen that the spreader girders are positioned longitudinally with respect to the quay, at centres determined by existing rail tracks. Each girder is 8ft deep and 65ft long and consists of two similar elements, one spaced on each side of the rail; four pairs of wheels are housed between these elements, which can be jacked down by hydraulic jacks bearing on a diaphragm on the top of the wheel housing. Two pairs of wheels are situated near one end of the girder, and the corresponding jacks are operated by a single pump. Similarly, the two pairs of wheels at the other end are worked by one pump, giving in effect a four-point suspension of the structure. To avoid overloading the pier when moving the gantry, it is necessary to bring the ballast carriage to the centre of the structure before jacking up the spreader girders.

Each of the four columns was made up of two 17in by 4in channels with angle-lacing, each pair of columns being cross-braced. Outrigger bracing was provided for the front

columns to allow the necessary clearance between them. The top lattice girders are connected by tie girders at the front and back. To allow warping of ships along the pier, it was necessary to design the cantilever girders so that they could be swung clear of the quay face. They are therefore provided with a vertical hinge over the front columns, which is securely locked by cotters in the top chord when the gantry is being employed for lifting. The design of the cotter removing mechanism



GANTRY WITH CANTILEVER ARMS SWUNG INBOARD

is such that the block carriage cannot move on to the hinged portions of the cantilever girders until the cotters are correctly in position. A detail of this part of the structure is shown in our illustration on page 597.

The hinged cantilever ends of the girders can be swung inwards by reins and hand tackle but such movement cannot take place until the front tie girder, which is secured by cotter pins and cotters, has been removed. When these cotters are removed the front tie girder is raised off its supports by hand lifting gear installed on the block carriage. It is lifted clear and carried back by the block carriage to a position on the gantry behind the hinges on the cantilever girders, after which the girders can be un-cottered and swung inboard.

Each bottom cantilever hinge consists of a footstep bearing, the hinges taking only the deadweight of the cantilever arm, and none of the loads due to lifting. Our illustration shows the jack and hand levers used to operate the cotters, of which there are two on each cantilever, and the inclined bearing at the top of the front column, on which the bottom chord of the cantilever rests in its outward position. On starting to pull the cantilever arm inwards, the bottom chord slides off this inclined surface and the footstep bearing then becomes operative. There are four pins at the extremity of each cantilever, on to which the front tie girder is dropped by the block carriage, and then secured by cotters. The hand lifting gear on the block carriage consists of a screw jack and bell crank lever arrangement.

For operating the gantry two 10-ton Wilson electric winches, which are standard on ships of the Alfred Holt Line, were made available. These winches are secured to the back spreader girder and operated by hand controller units. The steel wires from the winch drums are led upwards to sheaves on the back tie girders, thence through the main lifting blocks carried on the block carriage, and finally to anchorages on the front tie girder. Thus the block carriage can be moved backwards without affecting the height of the load and hoisting can be carried out without the pull on the lifting rope tending to move the block carriage. The two fixed blocks on the carriage are designed to resist internal torsion each being of all-welded box-construction, and containing six pulleys, with five pulleys in each of the lower blocks.

The block carriage can be moved with or without its load by hand winches mounted on the rear spreader girder, which have also been adapted for operation by electric motors. On the drum of each winch two ropes are wound in opposite directions and are reaved so that movement of the winches in one direction advances the block carriage, while movement in the reverse direction retracts it. The winch ropes are secured to the block carriage by compensating sheaves so that unequal pulls from the two winches will not affect the alignment of the block carriage on the track.

The ballast is carried on a ballast carriage, which can be moved fully outboard when lifting is taking place and brought inwards over the centre line of the gantry for travelling along the pier. Movement of the ballast carriage is effected by linking it to the block carriage and traversing both to the desired position.

The gantry's range of lifting is from a point slightly greater than 28ft in front of the centre line of the front column to a distance of 17ft 3in inside the front column. The crane rail of the block carriage is 48ft 6in above the deck of the pier. A loading chart was given to the shippers, showing the positions and clearances required by the gantry, so that locomotives should not be loaded in an inaccessible position.

The weight of the gantry is about 180 tons and about 70 tons of ballast is required in the ballast carriage. The wheel load, when travelling, is about 15 tons per wheel. The maximum load on the front column base is 138 tons (with a locomotive slung outboard). This load produces a distributed load of 4 tons per foot run under the front spreader girder, the corresponding loads in the pier being 21 tons per pile and 1·16 tons per square inch stress in the timber decking. The maximum pile load of 29 tons is, however, produced under the rear spreader girder, with a locomotive slung between the columns.

Electrical Interlocks

A purely mechanical stop prevents the block carriage from travelling out along the cantilevers when the cotters at the vertical hinge are not in position. Various other precautions have been afforded, however, by a system of electrical interlocks. Apart from the usual overwind limit switch, there are four limit switches on the gantry. The first of these prevents lifting unless all the cotterpins are in position in the front tie. A second stops the traverse of the block carriage 6in away from the front tie (this one must be disengaged to put the front tie in position). The third switch prevents lifting unless the ballast carriage is in its fully outboard position and the fourth prevents the loaded block carriage from traversing inwards beyond the rail track, at the distance from the front column given in the previous section of this article.

Power supply was brought by cable 400 yards to the gantry, a high tension a.c. supply being provided. A transformer and motor generator, which were conveniently available, were installed to give d.c. power. The winch cabs of the gantry are fully enclosed and provided with a full set of the usual contractors and resistances for speed control. Access has been provided to all parts of the gantry.

The elements of the gantry are of riveted construction, erected by site bolting. For convenience of handling the spreader girders and ties were each built in two pieces. The gantry was erected and tested in Glasgow, including an overload test of 110 tons, towards the end of last February and was dismantled and shipped before the end of March. It was subsequently tested a second time in Melbourne. Its design and construction probably constitutes the quickest work of its kind since the war and was mainly possible due to the adoption of methods used during the war, when groups of firms co-operated, each firm making only those parts which they were able to undertake. The cost of the gantry was about £35,000.

GANTRY IN OPERATION AT NELSON PIER

JOINT CONSULTATION IN INDUSTRY.—The Ministry of Labour announces that as from January 31, 1951, Mr. R. Lloyd Roberts, C.B.E., will relinquish the appointment which he took up in June, 1948, in charge of the development of joint consultation in industry.

Escape Equipment on High Speed Aircraft

WITH the realisation of combat flight at great altitudes and high sub-sonic speeds, upon the relatively sudden advent of the gas turbine, there arose special problems connected with the emergency exit of the crew. It became at once necessary to supplement the physical capacity of the pilot to effect an exit, which would ensure an adequate clearance of

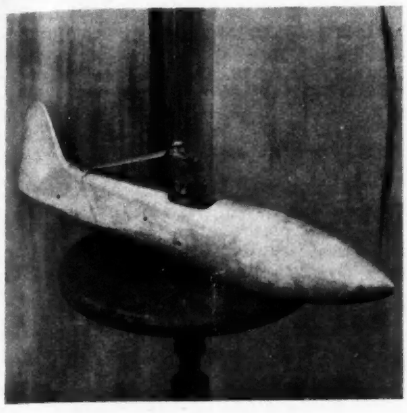


FIG. 1—AN EARLY EJECTION SCHEME

the abandoned airframe and then to sustain the airman during the descent. This operation would involve a period of free fall, to minimise the effects of lack of oxygen and sub-zero temperatures as low as —40 deg. Cent., during which time the airman was to be regarded as totally incapacitated.

The first firm to be associated with this

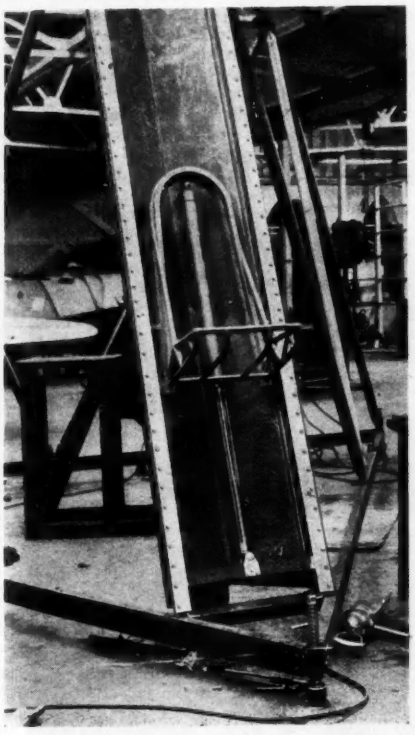


FIG. 2—PROTOTYPE SEAT ON TEST RIG

project was the Martin-Baker Aircraft Company, Ltd., in 1944, and the recent inclusion of the barometric valve completes this company's development of fully automatic ejection equipment, which is now standard in military aircraft.

It is interesting to recall from the early history of its development this company's first scheme, which we illustrate in (Fig. 1). It will be seen that after release of the canopy a spring-loaded radius arm pivoted near the fin initiated the ejection, after which aerodynamic forces then developed on the exposed arm, completed the ejection. Whilst this method worked in a simple way it was only contemplated with existing cockpits, the size of which did not then permit the present system of pilot and seat ejection by cartridge.

An early prototype ejection seat is shown herewith (Fig. 2), which illustrates the principle of the Martin-Baker equipment. The seat slides in "H" section guide rails on four closely grouped wheels and sliding movement is effected by the separation of the telescoping tubes, which form a gun when actuated by a cartridge. After ejection a spring-loaded drogue 3ft in diameter with a 9in apex hole, automatically develops to retard and stabilise the seat. This operation also causes the bottom of the seat pan to be presented to the airflow, from which the airman requires immediate protection.

After initial retardation the pilot releases himself from the seat harness and develops his own parachute. This prototype was first ejected from a "Defiant" aircraft in May, 1945, and was followed shortly by six other trials at speeds increasing up to 300 m.p.h.

In preparation for a "live" drop, a static rig (Fig. 2) 18ft high, was used to investigate the physiological aspects of high impulsive acceleration on the human body. One leg of the tripod rig was formed by the seat guide rails, which included ratchet stops at 3in intervals to provide for the arrest and descent of the seat. During a period of considerable experiment on the rig with the quantity of charge, the type of explosive, the swept volume and differential orifices, using both dummy and live subjects, significant complaints were established of physical discomfort in the lumbar region. During the fourteenth live test the subject was found to have suffered a crushed vertebra although the mean acceleration recorded was only $3\frac{1}{2}g$. This injury demanded that the nature of the acceleration be properly determined and, using a Kodak cine-camera, operating at 1000 frames per second, a series of time-displacement curves were obtained. Double differentiation of these cine records showed that the acceleration during the stroke increased initially at the rate of $220g$ per second up to a maximum acceleration of $100g$, which was sustained for several milliseconds, thereafter decreasing rapidly. Subsequent mechanical tests conducted on a human spine disclosed that the intervertebral discs could not sustain compression if the vertebra were not square to each other, and that any curvature would incur butting of the discs on the compression side of the spine, as is shown diagramatically in Fig. 3. This condition led to an arrangement of footrests so that the perpendicular alignment of the lower vertebra was automatically assured. Further to this arrangement it was decided to modify the acceleration curve and that finally adopted is shown (Fig. 4), which provides a mean value throughout the 42in stroke of $16g$ with a maximum of only $18 \cdot 7g$, yet retaining the desired seat velocity of 60ft per second. These dynamic characteristics were obtained by the employment of primary and secondary charges, the former initiating the first 11in of stroke being percussion-cap fired, after which the secondary charge became exposed and was face-fired by the hot gases from the primary charge.

Consideration of the g-time and displacement (l)-time curves showed the further advantage that the g-time curve was tolerant of considerable variation without critical effect on the area of the g-stroke curve, upon which depended the height of ejection. For these new conditions a rig 65ft high (Fig. 5) was built but in this case, after the arrest of the seat, a trolley was lowered on and connected automatically to the top of the seat and the complete unit was winched down, the ratchets being disengaged by virtue of the cable tension. All further records of the g-time charac-

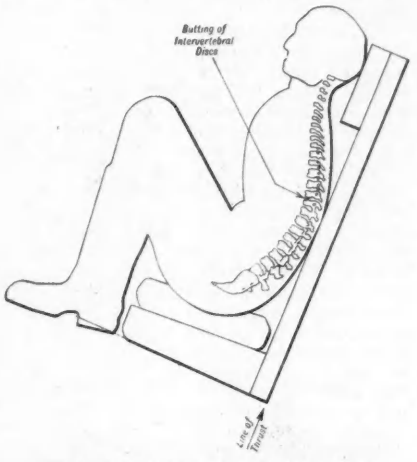


FIG. 3—INCORRECT SPINAL ATTITUDE

teristics were now obtainable by gas pressure analysis, using a standard gas pressure indicator recording on a drum rotating at constant speed. A further device to prevent serious injury was that of a face blind, withdrawn from the top of the seat and held over the face. This not only retained the head normally but also protected the face from the effects of air blast. After this stage there were no further complaints of physical discomfort.

The complete failure of the next tests showed the need to strengthen the supporting cords, which repeatedly snapped, and also to shoot the drogue more positively from the seat to ensure its development clear of the seat vor-

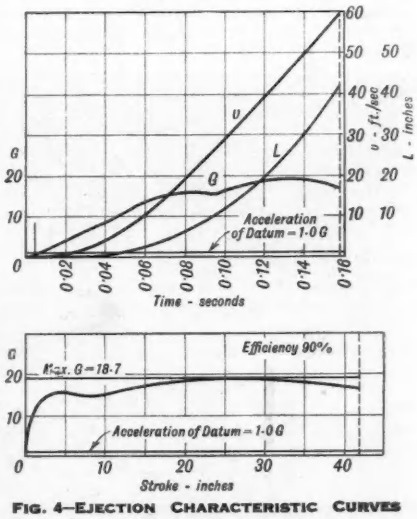


FIG. 4—EJECTION CHARACTERISTIC CURVES

tex. A drogue gun therefore was fitted to the side of the seat, consisting of a simple barrel and firing mechanism employing cartridge ejection of a free plunger to which the drogue was connected by line. A static line connected to the seat ensured that the seat rose 20ft above the aircraft before it was released and the drogue was then shot well clear. The drogue itself was now one of 2ft diameter, with a $7\frac{1}{2}$in diameter apex hole and twelve nylon lines.

In July, 1946, the first "live" ejection in Britain was made successfully at a speed of 328 m.p.h. and height of 8000ft. There followed a further series of thirty-five drops, with "live" and dummy loads, at speeds up to 500 m.p.h., involving further modifications

before this prototype seat was standardised on a production basis and became the Mark I seat. Seven tests of this series resulted in crashed seat landings, in one of which the operator failed to secure his release from the seat but survived with serious injuries. This Mark I seat was also used by the U.S. Forces for their own research purposes.

The seat, drogue, pilot's chute and dinghy, oxygen and water bottles weighs 172 lb. The seat pan was separately adjustable so that the canopy shrouded the seat top exactly and permitted sighting adjustments without affecting the length of the firing stroke. Thigh guards prevented the pilot's legs from being blown apart or separated by centrifugal forces should the seat spin on the drogue. The effect of centrifugal or vertical loading imposed by flight conditions, whilst having no appreciable effect on the ejection characteristic curves, was sufficient to render the pilot incapable of raising his legs to obtain the desired spinal attitude and hence the footrests were spring loaded downwards, remaining permanently at floor level. The pilot remained able, however, to operate the face blind under the maximum tolerable human acceleration of about $5\frac{1}{2}g$.

At this stage it was decided to make the seat fully automatic and the present Mark III seat (Fig. 6) was developed to carry out the whole ejection and descent procedure, assuming the pilot to be unconscious after operating the face blind. In most respects the Mark III seat is similar to the Mark I, but incorporates a timing mechanism with a barostat valve for over-ride purposes. The timing device releases the drogue shackle after a delay of four seconds provided the seat is below 10,000ft altitude. Above this altitude a barostat over-rides the timing device until the seat and occupant have fallen to this pre-set height. The drogue shackle is then released, freeing the drogue from the seat, and at the same time releases the harness locks, which attach the airman and his parachute to the seat.

FIG. 5—65FT TEST RIG

The drogue withdraws the airman's parachute from the pack and the seat falls away below him while his parachute develops in the normal manner.

Manual operation is still a requirement of the R.A.F. and if the airman wishes to attempt a non-ejected escape from the aircraft, assuming that is possible, he pulls the "manual over-ride" lever, thereby releasing his seat harness and parachute pack from the seat and, once free from the aircraft, operates his parachute by the manual rip-cord.

The effect of sudden decompression on ejection at very high altitudes is not yet regarded seriously, as the pressure differential in pressurised military aircraft is very much less than that obtained in civil machines and the pressure gradient experienced during the free fall period to 10,000ft, whilst probably causing some discomfort, is not likely to be injurious.

Present investigations of the use of ejection equipment include the development of apparatus with which to eject the airman from a prone position, the adoption of which has been contemplated in some countries. It is now regarded as debatable, however, whether the physiological and low-frontal drag advantages once associated with this position still justify the serious restrictions incurred to the field of vision. As the maximum acceleration which can be imposed upon high-speed aircraft in regions of reduced density is little more than $2g$, the need to prevent the emptying of the blood vessels in the brain is dismissed. Furthermore, the shape and frontal area of present fuselages is dictated by structural and fuel stowage factors, whereby the position of the pilot is no longer of any consequence.

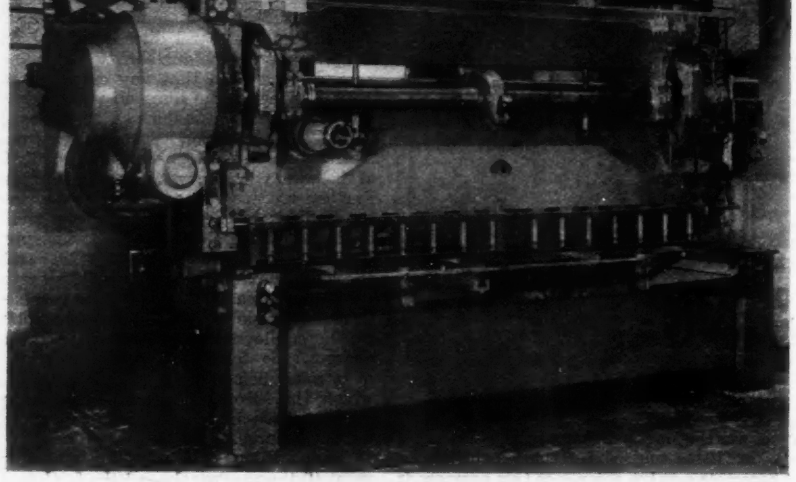
FIG. 6—MARK III FULLY AUTOMATIC SEAT AND EQUIPMENT

Precision Guillotine Shearing Machines

WE have received particulars of two types of high-speed precision guillotine shears now being made by Joshua Bigwood and Son, Ltd., of Wolverhampton. One of these machines, of the overcrank type, is illustrated in the engraving below. It is made in seven sizes for shearing mild steel $\frac{1}{16}$in thick, 6ft to 16ft long, up to $\frac{1}{4}$in thick, 4ft to 10ft long. The machines for dealing with sheet metal up to 10ft long are built in length increments of 1ft and those for sheets over 10ft in increments of 2ft. On standard machines the gap in the housings is 1ft but, if required, deeper gaps up to 2ft can be provided. The machines for light gauge sheet are designed for 60 strokes a minute and for the thickest sheets up to 25 strokes a minute.

In the overcrank machine the high-quality cast iron side frames are heavily ribbed in the tension areas and carry long slideways fitted with thick, renewable wearing strips, in which the top beam slides. Also mounted in the side frames are the crankshaft main bearings, which are of the loose-cap type and have renewable split sleeves. A large lug on the upper part of each side frame supports the top tie beam, which also carries the load-carrying bearings.

The top and bottom beams are heavy box-section castings having a cross section designed to provide the maximum resistance to the forces of shearing at the blade edge. The



OVERCRANK GUILLOTINE SHEAR

makers point out that in designing these beams the cross section is arranged to resist the tendency to edge-to-centre torsion when the shearing loads are imparted. Machined forked faces at the ends of the top tie beam fit over the side frames and the beam is held rigidly by through bolts and a large fitted pin. The inner bearing blocks for the crankshaft are mounted on machined facings on the underside of the top beam and the design is such that the operating eccentrics are held stiffly between bearings to ensure full support of the shaft at points of maximum thrust load. Springs used for balancing the weight of the top beam nest into the tie beam and two suspension rods are attached to the top beam by fork and pin connections. In the lighter sizes of machine only two main bearings are fitted, and the top tie beam, which is built of rolled steel sections, is arranged to carry the rocker gear used for operating the hold-down beam and the springs which balance the top beam.

Heavy forged alloy steel crankshafts fitted on the machines are supported in various bearing assemblies, each capable of holding the crankshaft to a definite line-up against the shearing loads and against the relatively heavy loads imparted by the hold-down cams. Wide eccentrics are fitted on the crankshaft close to the inner sides of the main bearings and on these eccentrics are mounted heavy cast iron eccentric straps with split phosphor bronze bearing liners. Extensions of the eccentric straps are coupled to the top beam by large diameter wrist pins carried in phosphor bronze sleeve bushes.

The drive assembly at the left-hand end of the machine is enclosed in a cast iron gearcase, which carries in taper and roller bearings a hardened and ground wormshaft. A wormwheel is mounted in a long sleeve bearing on an extension of the crankshaft, and clutch thrust is taken by self-aligning ball thrust bearings. It will be noted that an underdrive worm gear is used and the worm rotates in an oil bath, forming the lower part of the gearcase. Drive is transmitted from the motor at the rear of the assembly through vee belts to a pulley bolted to a small but heavy flywheel. This flywheel contains an adjustable overload friction clutch, which protects the shear against overload. The flywheel is run at a relatively high speed so that the stored energy is available to assist the motor during the actual cutting stroke of the machine. A motor having a higher slip characteristic than normal is fitted and generally high-torque squirrel-cage motors are used. With this arrangement the makers state that the combination of stored energy in the flywheel and the high or medium slip squirrel-cage motors give a useful overall saving in current consumption.

The clutch sleeve, which engages a driven clutch ring on the wormwheel slides on the crankshaft extension. A dog clutch having five or more possible interference positions is fitted to reduce time loss on engagement.

Four-edged blades are bedded directly on to blade recesses in the beams and these blades must be packed to fine limits to hold to the close shearing tolerances to which these machines are capable of working. Blade clearance is set by adjusting the lower beam as a whole in relation to the top beam through adjustment screws at the front of the machine.

A heavy forged steel hold-down beam carries a series of closely spaced spring-loaded plungers. This beam is operated through push links attached to rocker levers, which are actuated through hardened rollers by the hold-down cams on the crankshaft. The hold-down beam slides in ways attached to the cover plates of the top beam slideways. Machines can, if required, be supplied with fixed hold-down beams fitted with hydraulically-operated plungers for work-holding purposes.

Various forms of clutch operation are available, but usually a foot-bar across the front of the machine is used to control a push-button operating a B.T.H. "Thruster," which, in turn, actuates the clutch mechanism. Alternatively a foot-valve controlled pneumatic system can be fitted for clutch operation.

A brake gear on the right-hand end of the crankshaft provides a convenient method of fine control of the top dead centre position, when using the cam-actuated clutch of the machine.

To make possible precision working with these shears specially designed back and front gauges are fitted. Back and front gauge stop-bars are carried on slides, which are supported on arms bolted at their inner ends to the underside of the top beam. These slides are operated through machine cut screws mounted in taper roller bearings and are driven through bevels and coupled by cross-shafts. Full provision is made for side-to-side adjustment and either hand or power-operated means can be used for gauge setting. At the front of the machine, gauge position is indicated either by double-scale micrometer rotating dials or electrically-operated gauges. With power-operated gauges push-button operation for fast and slow gauge movement is available and the control station can be mounted at a convenient point to suit the operator.

All the major bearings are lubricated by a single-pressure pump grease lubrication system.

The firm is also producing four sizes of under-crank shearing machines with many similar features of design for cutting mild steel plates from $\frac{1}{16}$in to $\frac{1}{4}$in thick up to 10ft long. It states that on a 10ft machine, cutting up to $\frac{1}{4}$in mild steel plate, operators have maintained tolerances within plus or minus 0·005in over long periods at high production rates.

Heavy-Oil Engine Working Costs

At the annual general meeting of the Diesel Engine Users Association, on December 14th, there was presented the "Report on Heavy-Oil Engine Working Costs (1948–49)," in which the relevant factors relating to the running of heavy-oil engines are set out in a series of tabular statements and illustrated graphically. The report first comments briefly upon the method of presentation of the data and reminds readers that the report is a compilation of data provided by engine users without any expression of opinion by the Working Costs Committee. The total number of stations sending in returns was sixty-eight, an increase of four over the previous year, and these are listed alphabetically together with appropriate table references. The abbreviations used for definitions are given and the methods explained by which the different load factors, efficiencies and powers are calculated.

In the report is set out the detailed information relating to the running costs per unit generated for heavy-oil engines, at home and overseas stations respectively. Separate sections of the tables deal with mechanical injection engines and with installations containing air blast and mechanical injection engines. For each undertaking the total engine cost per unit generated is shown graphically in the report and for comparative purposes there is drawn on the graph a standard curve for a 220kW air injection engine and a curve representing a modern (airless) injection engine. All points are plotted in terms of fuel consumption in pounds per kilowatt-hour to a base of plant load factor. In the report a table gives the average fuel consumption and its relationship to the standard curve for the years from 1922 to 1949, and it is shown that the consumption before 1932 was above the standard rate, but since that year it has been below. Another table lists the stations in order of rated b.h.p.-hours run per gallon of lubricating oil, and the list is repeated in another statement, but on a basis of the ratio of fuel to lubricating oil consumed, while yet another table gives the average rated b.h.p.-hours per gallon for all stations for the years 1922–49. The figures given in the latter table record a considerable increase since 1922, but the average of 2160 b.h.p.-hours per gallon for 1948–49 is 340 units below the result for 1945–46. A graph in the report, which is reproduced from last year, shows the renewals and replacement costs, one curve indicating the average taken over the sixteen years previous to 1938 and another representing the estimated costs for 1944.

There is included a number of notes and comments received from members. The cost variables given in several tables in the report, one of which refers particularly to the costs per water horsepower-hour for waterworks heavy-oil engines at sixteen home stations, are analysed and for each item a divergency factor is given. These show the percentage variation from the average of results from any group of engines under consideration. The technical details of engine performance are given in the last tabular statement of the report; one section relates to installations containing mechanical injection engines and another section refers to those having air injection engines. Both sections give particulars of engines; bearing clearances and diameters; engine log details; information regarding cylinder liners and gudgeon pins; the hours run between overhauls; the life in hours of various working parts; the cooling water, exhaust and air systems employed, notes on lubricating and fuel oil, and a final column contains remarks upon the causes of trouble.

Results of Double-Deck Train Trials

During the past twelve months intensive trials have been carried out under varied traffic conditions, of the experimental double-deck passenger train, which was introduced on the Eastern Section electrified lines of the Southern Region, British Railways, as a possible alternative to longer trains for reducing peak-hour congestion. As a result of these trials it has been decided that the double-deck train does not offer a satisfactory long-term solution of the peak-hour congestion problem and that both public interest and operating efficiency will be better served by running longer trains with ten coaches instead of eight, the coaches being of normal type but of modern, commodious design, and lengthening platforms where necessary to accommodate them. The seating capacity of the experimental eight-coach, double-deck train is 1016 passengers, compared with 772 in an ordinary eight-coach train and 945 in the ten-coach trains of new design.

The trials have revealed that the advantage of extra seating capacity within the double-deck coaches is more than outweighed by slower working in passenger stations, owing to the longer time required for passengers to entrain and detrain. The double-decker train, which was described in The Engineer of November 11, 1949, affords one door per twenty-two seats, compared with one door for ten or twelve seats in ordinary compartment stock. In addition, the double-deck coaching stock has been found to suffer from a number of physical disadvantages. There is less cubic capacity per passenger and the seats are smaller and less comfortable. Owing to the necessarily small clearances within bridges, tunnels, &c., of double-decker coaches it has been found difficult within the limits of the loading gauge to provide adequate ventilation to the upper deck. A further disadvantage is that because of its dimensions, double-deck coaching stock can be used only on a limited number of sections of the Southern Region electrified system.

After full consideration of the results of the double-deck experiment and while recognising the ingenuity of its design and construction, the Railway Executive has, therefore, reached the conclusion that as a long-term policy "double-decking" is not the most satisfactory answer to peak-hour congestion.

Plans are now being pressed forward for the provision of ten-coach trains for peak-hour service on certain of the busiest Southern Region (Eastern Section) suburban routes, including those from Charing Cross and Cannon Street to Dartford and Gillingham (Kent), via Woolwich, Bexleyheath and Sidcup; Sevenoaks via Orpington; Bromley North and Addiscombe, Hayes and Sanderstead.

In conjunction with the introduction of ten-

coach trains (which will require the construction of sixty-six new two-coach sets as well as the modernisation of 132 four-coach trains), lengthening of platforms at many suburban stations and other extensive engineering work will be required, including major alterations at Cannon Street station. Under present conditions the provision of the necessary rolling stock, the civil engineering works and the equipment for the additional electrical supply required for longer trains, will take a considerable time but the Railway Executive states that every effort will be made to implement the scheme as quickly as possible and introduce it in stages.

Institute of Metals Appeal for Financial Support

THE Institute of Metals has issued an appeal to industry for support in its work by annual subscription under covenant. In making this appeal the Council points out that the Institute of Metals has become an important factor in the progress of the science and practice of non-ferrous metallurgy and, therefore, in the scientific welfare and advancement of all the industries concerned with the manufacture, treatment and use of non-ferrous metals and their alloys.

The Institute's work is paid for mainly by the personal subscriptions of its members, and before the war, with the aid of income from its Endowment Fund and donations from industrial companies, members were able to support the costs of the Institute's work. As a result of the growth in metallurgical technology, a considerable expansion of the Institute's activities has been necessary since the war. This growth has coincided with heavy increases in the costs of its services and a reduced income from its investments, so that, in spite of an increase in the annual subscription, the members will be unable to support this work without substantial financial assistance.

Despite steps by the Council to increase the rate of subscription and expand sources of revenue, and by exercising all possible reasonable economy, the deficit on regular income is now about £2000 a year.

The Council believes that industry will not wish the Institute to reduce the scale and effectiveness of its work or to draw continually on its accumulated funds and so create a situation which—already becoming serious—would lead in the end to a financial crisis. It resolved, therefore, to appeal to the non-ferrous metal industries, in the widest sense, for regular financial support under covenants of not less than seven years. An additional income of not less than £5000 per annum is required to place the Institute in a reasonably safe position, to allow it to meet the increasing demands on its facilities for publication of original work, and to undertake without embarrassment such further activities as will promote its aims. The Council states that it would prefer to receive contributions of moderate size from a large number of companies connected with the industry, rather than that subscriptions should be restricted to a small number of large sums, and it is hoped that all firms in the industry, both large and small, will give their direct support to the Institute's work.

The Council hopes that the companies engaged in the industry, as well as those in the "user" industries which benefit from its work, will not only respond to this appeal, but will also encourage as many as possible of the members of their technical staffs to join the Institute and to take an active part in its affairs.

The appeal for support is being sent out only to companies whose works or headquarters are in Great Britain. The Council would, however, welcome regular subscriptions from private individuals and also from any companies, outside the British Isles, which would like to take this opportunity to support the Institute financially. The Secretary will send to any firm or individual interested a copy of a printed form of covenant for subscriptions in response to this appeal.

South African Engineering News

(From our South African Correspondent)

Development of Electrical Industry in the Union

The Associated Electrical Industries, Ltd., formed over eighteen months ago, an association with the First Electric Corporation of South Africa, Ltd. The purpose of this association was to manufacture in South Africa the types and quality of electric equipment which had hitherto only been available through import, and to ensure maximum operating efficiency by combining the existing manufacturing facilities of the South African firms with the technical experience which the British firms possess.

As soon as the agreement had been drawn up, engineers of the First Electric Corporation were sent overseas to the Metropolitan-Vickers works at Manchester and the British Thomson-Houston works at Rugby, Willesden and Birmingham, to be instructed in the manufacture of equipment which included an extensive range of dies, jigs, fixtures and patterns. Some of this equipment was supplied by the overseas associates while a considerable amount was manufactured in South Africa. In less than a year the South African factories had retooled and started the manufacture of a range of electrical equipment to the specifications of the Metropolitan-Vickers Company and the British Thomson-Houston Company. The workmanship is identical to that insisted upon in the British factories, and the locally made products carry the same guarantee of quality and performance.

To meet the existing and increasing demand for electric motors by mines and industries the First Electric Corporation is at present concentrating on the production of protected motors of the squirrel-cage and slip-ring types, with outputs from 1 h.p. to approximately 2000 h.p. In addition, the Corporation have gone into production with totally enclosed motors and totally enclosed fan-cooled motors up to 70 h.p. Transformers are being produced from 50VA to 1500kVA. The highest primary voltages do not exceed 11kV, and the secondary voltages are satisfactory for all supplies in African territories. The usual range of current transformers and transformer welding sets are also in production. Included in the range of equipment now being made are switchgear cubicles up to 11kV with a rupturing capacity of up to 250MVA. The range will be increased soon by the addition of the well-known G.A. and Q.F. vertical isolation drop-down type of switch cubicles up to 11kV, with a rupturing capacity of 250MVA at 6·6kV. Liquid starters and liquid controllers covering an extensive range are now being made by First Electric, while oil immersion starters and controllers, including standing equipment, will begin to come off the production lines shortly.

The castings for the equipment made by First Electric and L. H. Marthinusen are produced by African Malleable Foundries, Ltd., a subsidiary of First Electric. Another point of interest is that the Anglo American Corporation of South Africa, Ltd., is a large shareholder in First Electric. The First Electric factory occupies a site of 20 acres, the main building having a floor space of 3 acres under one roof.

Many large installations have been carried out in South Africa by the companies in the Associated Electrical Industries group. Examples of such installations are the generating equipment for the Klip River power station, one of the largest power stations in the world, transmission equipment for the Rand Power Supply system, electric railway equipment for the South African Railways, and a large number of powerful electric winders for the gold mines on the Rand and in the Free State, and for the copper mines in Rhodesia.

Titaniferous Ore Deposits in South Africa

Attention has recently been directed to the large South African occurrences of titaniferous ore by Mr. D. G. Malherbe, Government mining engineer, when he addressed a joint meeting of the University of Witwatersrand and the Chemical, Metallurgical and Mining Society of South Africa. According to Mr. Malherbe, there are many mineral occurrences in South Africa which are known, but which, owing to a weak demand, have not been satisfactorily prospected. Mention need only be made, he said, of uranium in the Rand ores and titanium.

There are titaniferous ores in astronomical quantities in the Union. In the few samples that have been taken the titanium content is 20 per cent or less, but there is no doubt that closer prospecting will reveal areas where the mineral occurs in a more concentrated form, and the probability is that large tonnages with a titanium content of 40 per cent or more will be found, which is the type of ore that is being exploited in Canada at the present time. According to the Government publication, "Mineral Resources of the Union of South Africa," considerable quantities of titaniferous magnetite are associated with the Bushveld igneous complex in the Central Transvaal. In places the TiO_2 content reaches 20 per cent. Large deposits of a similar type, also carrying up to 20 per cent TiO_2, occur in Natal at the confluence of the Tugela and Mambula rivers, and in the Transvaal near Heidelberg and also near Piet Retief. None of these occurrences has been systematically examined, and it is probable that patches or bands, rich enough in ilmenite to be exploited, do exist in them.

Some of the Gordonia pegmatites carry fair quantities of ilmenite, together with ilmenorutile, struverite and other titanium-bearing minerals, but at present there is no information as to how much of the titanium content would be exploitable. Some attention has been paid during the past few years to certain sands occurring along parts of the Natal coast, and particularly at Durban. Examination of heavy residues from these sands shows that they may contain as much as 85 per cent of ilmanite, together with about 8 per cent of zircon.

Very good examples of red-brown rutile have been obtained from the Eastern Transvaal. These are all in pegmatitic material and are well worth investigation. Crumbly patches of pure rutile in a gritty sandstone have been found in the Nylstroom and Potgietersrust districts, but no accurate report on these occurrences has been received.

Manufacture of Abrasive Products

An important new industry is to be established on the Rand, involving a substantial investment of American capital in South Africa. In association with the Anglo-American groups and other South African interests, the Norton Company, of Worcester, Massachusetts, U.S.A., has formed a local company for the purpose of establishing on the Rand a factory which will produce a wide range of abrasive products for the South African market. Known as Norton Abrasives, S.A. (Pty.), Ltd., the new company has purchased 6 acres of ground in the Isando industrial township near Kempton Park, Transvaal. Plans for the factory buildings are now being prepared and production will start in the new factory next year.

The Isando factory will produce grinding wheels and various other types of abrasives. An important product of the factory will be diamond grinding wheels, for which local industrial diamonds will be used.

A TWIST DRILLS INSTRUCTION BOOK.—We have received from Firth Brown Tools, Ltd., Carlisle Street, Sheffield, its latest publication, No. 169, "Twist Drills Instruction Book." This pocket-size book of one hundred and fifty pages is full of detailed information on twist drills, combined drills and countersinks, to B.S.S. No. 328 : 1950. It deals in a clear, concise way with all aspects of drill design, grinding and servicing; causes of drill failure; drill selection and special designs of drills, &c. A number of tables of feeds and speeds, tapping sizes, conversions and similar useful data add to the value of the practical information given in the book.

Productivity Team's Report on Diesel Locomotives

THE report of the productivity team from the British diesel locomotive manufacturing industry, which visited the United States in the early part of this year, has now been issued by the Anglo-American Council on Productivity. The introductory statement to the report points out that early in 1930 the diesel-engine manufacturing industry of America was given an enormous opportunity when the extensive and costly change-over from steam to diesel traction was undertaken by the railways of the country. As the American railways do not build their own locomotives an immense market was opened to engine manufacturers and the diesel-engine industry quickly offered a power unit suitable for railway requirements.

The report deals in some detail with market research and sales organisation; designing for productivity; organising for productivity; costing and accounting; management; labour, and workshops control and techniques. In discussing factors which have contributed to the high level of productivity in America, under these headings, the report puts forward a number of recommendations. In making its recommendations the team kept in mind the fact that in America there is a large home market and units can be designed for a single standard gauge, a generous loading gauge and heavy axle loading. British industry, on the other hand, has to rely largely on world-wide export markets with a variety of gauges and operating conditions.

Some of the recommendations put forward in the report are of particular interest. It is considered that as many members as possible of sales staffs should have technical experience and training, and they should play a vital part in a general drive towards increased basic standardisation. Design staffs should aim at the principles of unit construction and an immediate close study of this subject should be undertaken by the industry of this country. A more enterprising approach should be made by design staff to what may appear to be unorthodox and they should have a better appreciation of the problems of the manufacturing departments.

In the section on labour the report points out that consideration should be given to the abolition of piecework and the substitution of an enhanced hourly rate, with time study, in order to establish agreed standard times, and it states that piecework is exceptional in America. A working week is forty hours and overtime is uncommon in the industry in the United States, where full utilisation of labour is made possible by the almost complete absence of waiting time. Tradesmen are not essential to production in American works, because of simplification of methods, and the absence of restrictive craft practices broadens the field from which labour can be drawn. If the simplification of methods recommended in the report is achieved it is stated that craft trades and trade apprenticeship as at present known in Great Britain could be abolished.

Management in this country, it is considered, should seek the opportunity to see American management in action because its attitude to managerial responsibility has such an important bearing on productivity. The report points out that it is unreasonable to expect from organised labour the sacrifice of long-standing principles unless management gives a lead by putting into effect the lessons learned from such a study. Industry in this country should, it is stated, introduce a higher percentage of better supervision and a close and more personal relationship should be fostered between management and foremen.

In making these and a number of other recommendations the team reports that it saw in America how much long-term forecasting of requirements assists designing and forward planning, and how an "aggressive" sales policy and skilful publicity can persuade customers to accept standardised products. In general it was found that the American worker produces more than his British counterpart. This fact is considered to be due not so much to greater individual effort as to high utilisation of working time, resulting from skilful designing for productivity, good planning and service on the shop floor, coupled with a closer degree of supervision. Both management and men have a clear idea of the time required for a job, the men know that their performance is watched and strive to attain the necessary output. In the event of failure to maintain output the men know they will lose their jobs.

Discrepancies Between the Calculated and Measured Wavemaking of Hull Forms

ON November 17th a communication from the National Physical Laboratory was read by J. R. Shearer, B.Sc., before the North-East Coast Institution of Engineers and Shipbuilders in the form of a paper entitled "A Preliminary Investigation of the Discrepancies Between the Calculated and Measured Wavemaking of Hull Forms."

The paper expresses the need for an analytical technique for the interpretation of experimental work and for the analysis of hull forms in terms of resistance and for a detailed study of the errors involved in theoretical solutions. The solution of the hydro-dynamical problem set by a moving hull would have to satisfy conditions at the fluid boundary, at the hull surface, at the free surface of the liquid and also the equation of wave motion and of viscous flow. It is usually assumed that resistance can be separated into mutually independent components but in this investigation the following factors are considered:—skin friction resistance, which is assumed to be that of a flat plane of the same roughness, length and surface area as the hull, wave motion effect being neglected; wavemaking resistance which is assumed to be that of a similar hull in a non-viscous fluid, neglecting the effects of viscosity and of changes in velocity due to skin friction; the effect on skin friction of wave motion and on wavemaking of boundary layer flow.

Practical solutions of wave motion equations for a hull depend upon simplifying assumptions. They are that velocity changes round the hull are relatively small, the height of the waves are small in relation to their length, sinkage and trim have no effect, the angles made by the hull surface with the centre-line plane are small and the fluid is non-viscous. Reference is made to two methods for the approximate calculation of wavemaking. In the first, by Dr. Guillotin, the hull is represented by the summation of a system of wedge-shaped elements, which are defined in terms of second differences of hull offsets. Professor Havelock suggested the second solution, in which the hull is replaced by a small number of sources of finite strength distributed over its centre-line plane. After a trial the second method was adopted the main reasons for the choice being given in the paper.

The principal expressions given by Professor Havelock for obtaining the source distribution are quoted, followed by a discussion on the equivalence of calculated and measured wave phenomena. In any comparison between measured and calculated wave characteristics there are discrepancies, some of which, such as the effects of sinkage and trim, can be eliminated experimentally. Viscosity is given as the major cause of discrepancies for narrow hulls, while increased beam will increase the effects of wave height.

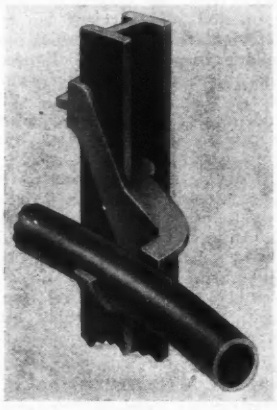
Three members of a family of parabolic forms are mentioned as being selected for study and consideration is given to the elimination of any discrepancies likely to be caused by lack of refinement in the computation. A hull subdivision of forty equidistant transverse sections and three water-planes was adopted. The practical calculations involved are described, the experimental work carried out is detailed, the accuracy of the results assessed and the method of presentation explained. A general comparison of the measured and calculated results is made and commented upon and there is an analysis of the discrepancies in which the effect of various factors is considered.

Seven conclusions are listed, as follows: the calculations using three lines of forty sources each reproduces the main wavemaking features; calculations for this distribution agree well at all speeds with those for an infinite distribution; reduction of sources to twenty still reproduces the main wavemaking features; the physical equivalent of the assumptions regarding sinkage and trim is most accurately obtained when the model is allowed to trim naturally; major discrepancies in theoretical results may be attributed to initial assumptions rather than to the method itself; the main discrepancies are due to the effect of the profile on the distribution and of the boundary layer; it is possible to calculate simple source distributions to give the correct wave profile and it may be possible to calculate corresponding wave resistance. Finally, the author states that he is of the opinion that the results are encouraging, as no major snag has appeared to prevent this method being used as a practical method of analysis.

A Girder Clip

A NEW form of clip, which can be quickly and easily attached to girders and used for supporting pipes, pulleys, platforms, scaffolding, &c., has been developed by Follsain-Wycliffe Foundries, Ltd., of Lutterworth, near Rugby.

This clip, which is known under the trade name "Wynip," is illustrated below. It consists of a single casting of Blackheart malleable iron incorporating a semi-circular hook and two sockets which grip the edge of a girder.



GIRDER CLIP

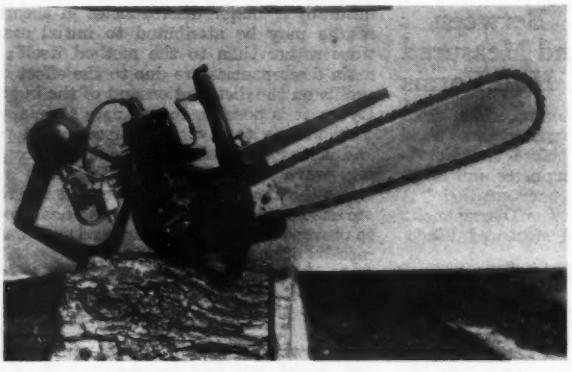
The inner faces of the sockets are tapered to give the maximum grip without slip when a load is applied to the hook, and they are closed on the girder by the hammering in of the inner tongues on the back of the girder flange. The taper and set of the sockets on the clip are such that, as the load on the hook is increased, the hold on the girder becomes firmer. A light blow under the hook quickly releases the grip on a girder when the load has been removed. The new clips are designed to support up to 1-ton weights and are made in a range of sizes to fit various girder sections.

An Improved Portable Power Saw

WE reproduce on page 604 a photograph of the latest design of "Danarm" portable power saw, which is now being supplied by J. Clubley Armstrong Danarm, of Abford House, Wilton Road, London, S.W.1. This saw, which is built for use by a single operator, weighs only 42 lb., some 14 lb less than the earlier model. It is claimed to be capable of cutting down trees of 2ft diameter in well under a

minute. The new unit follows closely the straightforward construction of previous models and, in its design, care has been taken to incorporate strength with reduction in weight, and to make possible long trouble-free operation on remote sites.

The redesigned 4 h.p. Villiers petrol engine now used to drive the saw has a two-bearing crankshaft and improved roller type big end bearings. It has a flywheel magneto and a built-in fan which is stated to give efficient cooling even when working under tropical conditions.



PORTABLE POWER SAW

The cylinders fitted to the engines are of particular interest, in that they are aluminium castings and have chromium-plated bores—no liners being fitted. In the course of manufacture the bores of the cylinder castings after machining have special chrome deposited on them. The surface finish of the bores is between 20 and 30 microns, and it has been found that the degree of wear after a long period of service is extremely small. The infinitesimal wear which takes place in the cylinder bores makes it only necessary to change the pistons and rings after a long period of service.

The mortice type chain saw blades of the machine can be reversed so that by making the bottom groove the cutting groove the saw is given a double life. Each tooth of the self-setting saw is readily accessible for sharpening purposes. In addition to the standard 22½in and 30in blades, a new narrow 14in blade can now be supplied for felling and cross cutting small timber. For cutting at angles the saw unit assembly can be tilted relative to the handle grip, carburettor and fuel tank, which remain vertical.

Marine Reduction Gear

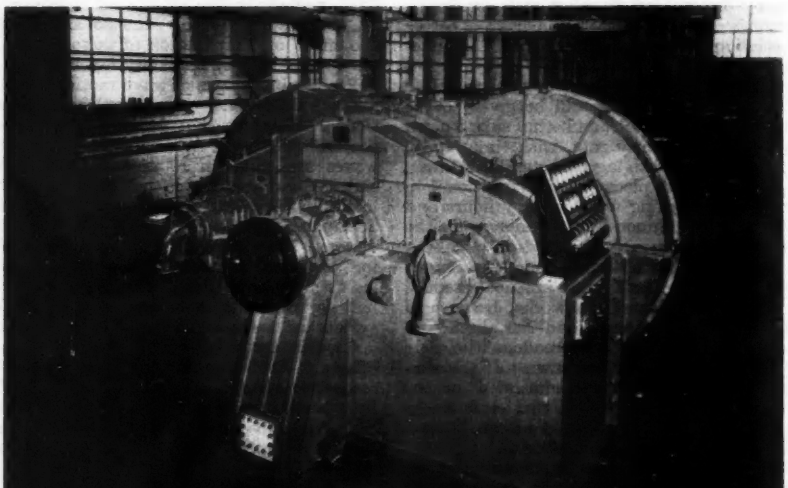
THE "Atlantic Duchess," recently completed by William Gray and Co., Ltd., is the first of two 12,500 tons deadweight motor tankers. It has propelling machinery which consists of two Gray-Polar diesel engines, driving a single shaft through Vulcan couplings and a reduction gear manufactured by David Brown and Sons (Huddersfield), Ltd. The two six-cylinder, two-stroke, direct reversing engines develop a total of 4720 b.h.p. at 250 r.p.m., and the combined gearing and hydraulic couplings transmit 4300 b.h.p. at 110 r.p.m. to the propeller shaft at the gearbox shaft coupling.

The twin-engine single-reduction gear unit, which can be seen in our illustration, weighs 51 tons and is horizontally disposed, employing single helical gears. The pinions are disposed at 114in centres, one on each side of the main wheel and connected to a hydraulic coupling, housed in the gearbox, on each engine input shaft.

Enclosing the unit is a fabricated steel case split along the common horizontal plane of the shafts and of considerable rigidity. The lower portion, in which are welded the cast steel bearing housings, is of box construction, while the upper part of the casing is of single-wall design, divided into sections to provide easy access, each section being well ribbed to minimise resonance. The cast iron bearing caps are independently bolted and dowelled to the lower casing. The wheel and pinions have rims of 45/55 tons per square inch heat-treated manganese molybdenum steel, shrunk and pegged to a cast iron centre, which is pressed and keyed on to the shaft. After assembly of the rim, centre and shaft, the teeth are precision cut, using profile ground hobs. Then, after balancing, the wheel and pinions are mounted in the casing. Forged steel-backed white metal bearings take the journal loads from the gears.

The slip for the Vulcan hydraulic couplings amounts to about 3½ per cent and they are carried in white metal-lined bearings with Michell thrust blocks to take end thrusts from couplings and pinions. Designed to add to, or subtract from, the thrust pressure, the blocks take up 189 lb per square inch ahead and 256 lb per square inch astern. The Michell thrust bearing, which absorbs the propeller thrust of 80,000 lb per square inch, is fitted in the gearbox at the after end of the main wheel shaft.

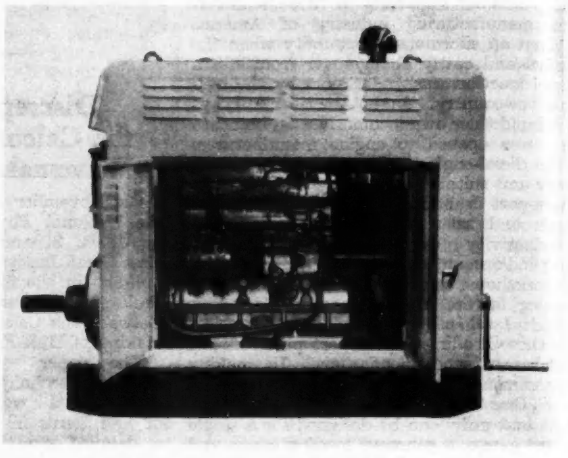
Forced lubrication has been adopted and the lubricating oil is drawn from a sump in the bottom of the gearcase and delivered to a tank, from which it is gravity fed at a pressure of 10 lb per square inch through spray nozzles to the gears. There is an independent feed to each bearing and oil is supplied to the coupling through a bore in the pinion shaft. The oil passes through a "Zwicky" dual strainer and is cooled by a Serck heat exchanger, which is supplied with sea water by a pump chain driven from the shafting.



MARINE REDUCTION GEAR

A Diesel Engine Power Pack

A RECENT addition to the range of power units made by F. Perkins, Ltd., of Peterborough, is the self-contained engine unit or "power pack," illustrated below. This new unit incorporates one of the firm's "P.G. series" six-cylinder industrial diesel engines, mounted on a rigid fabricated base frame and enclosed by a sheet metal canopy with large access doors on both sides. A fuel tank incorporated in the unit has sufficient capacity to permit six hours' running at full load.



55 B.H.P. POWER PACK

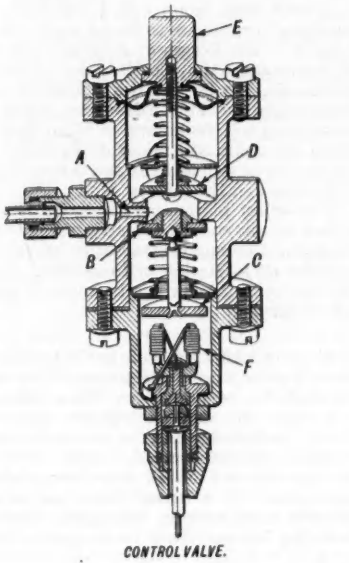
The engine has a bore of 3½in by 5in stroke and is rated at 55 b.h.p. at 1600 r.p.m. continuous duty at sea level in temperatures up to 66 deg. Fah. The power take-off is by means of a heavy duty hand-operated industrial clutch and the power transmission shaft, which projects from the rear of the unit, has a keyway cut in it for the fitting of a pulley or a coupling. The radiator and oil cooler supplied as part of the unit are designed for adequate capacity to permit the operation of the set under tropical conditions.

A 12V electric starting equipment is provided and all the necessary gauges and starting and engine controls are grouped together on a clearly visible instrument panel at the power take-off end of the unit. A built-in box is arranged for carrying a set of maintenance tools and selected spare parts.

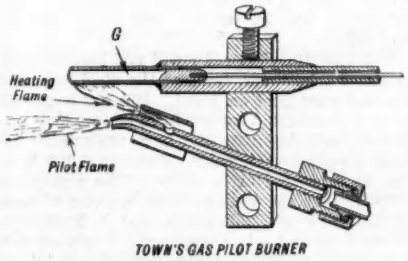
An Automatic Gas Pilot Control Device

A NEW automatic pilot device, which has been introduced by the British Thermostat Company, Ltd., Sunbury-on-Thames, Middx, is designed to shut off the flow of gas in a mains supply in the event of flame failure in a gas-burning appliance. The arrangement and operation of this device, which is self-contained and requires no external source of power, can be seen from the drawing we reproduce below.

The device is installed with a chamber which forms its upper part, connected to the main burner of the appliance and the chamber in its lower part connected to the gas supply mains. In a neck connecting the two chambers is a small outlet port *A* connected to the pilot burner. The spindle of a spring-loaded shut-off valve *B* in the lower or gas inlet chamber has an armature *C* at its lower end. In the gas outlet chamber is a second spring-loaded valve *D*, which, when depressed through its spindle by a push button *E*, forces the shut-off valve down to bring its armature into contact with the electromagnet *F*. This electromagnet is energised by a thermocouple *G* in the pilot burner assembly, shown in the second drawing.



CONTROL VALVE.



TOWN'S GAS PILOT BURNER

PRINCIPLE OF GAS PILOT CONTROL DEVICE

In the pilot burner assembly a small secondary flame is arranged to play on the tip of the thermocouple whilst the burner is alight. Whilst this secondary flame heats it, the thermocouple, generates sufficient potential to energise the electromagnet below the shut-off valve.

Before lighting the pilot burner the push button is depressed and held down to keep the valve *D* on its seating. With the valve in this position the shut-off valve is also depressed and kept open with its armature held against the electromagnet. The open shut-off valve allows gas to flow through the pilot burner outlet whilst at the same time the valve *D* prevents gas passing into the upper chamber and through the main burner outlet. After the pilot burner has been alight for about thirty seconds its secondary flame has generated enough heat in the thermocouple to energise the electromagnet. Pressure on the push button is then released, the valve *D* is raised by its spring to allow a full flow of gas to the main burner supply pipe, whilst the shut-off valve is held open by the electromagnet. Should the pilot flame be extinguished for any reason, the cooling thermocouple ceases to energise the magnet and the armature is automatically released within sixty seconds. The shut-off valve is then raised by its spring to cut off the gas supply to both the pilot and main burner lines.

The pilot burner shown in the drawing we reproduce is designed for town's gas supply and a different design is used for liquefied fuel (petroleum) gases.

These pilot devices are made for main gas flows of 85 cubic feet per hour at 0·2in w.g. pressure drop, and a pilot flow of 2·3 cubic feet per hour at 2·5in w.g. inlet pressure. For liquefied fuels they are made for a main flow of 30 cubic feet per hour at 0·1in w.g. pressure drop, the pilot flow being 0·17 cubic feet per hour at 11 in w.g. inlet pressure.

American Engineering News

Iron Powder for Powder Metallurgy

A new iron powder for powder metallurgy is being produced on a pilot plant scale by the Powdered Iron Corporation, of Detroit, Michigan. The powdered iron resembles Swedish sponge iron physically but is said to have the purity of best electrolytic iron powder. A combination of particle shape and high purity is claimed to give the powder the advantages of high compactibility, lower sintering temperatures, more uniform particle size and improved electrical properties. Ordinary cast iron or mild steel scrap in the form of borings or turnings serve as raw materials for the new process. They are placed in a chemical bath in iron trays and become the anode in the electrolytic reaction which takes place. Iron is dissolved out chemically and is deposited from the solution on a mercury cathode, which becomes impregnated with the iron. The iron is then recovered in fine particle form by distillation of the cathode, soft pulverising and air classification. There is no severe mechanical reduction of a large mass, so that the dendritic structure of the powder, as obtained from the cathode, is not destroyed. The particle shape of the material can be translated into greater green strength in compacts, due to the interlocking of the particles, or, alternatively, into greater compressibility of the powder, due to the readiness with which the dendritic structure can be compacted. As a result, usable compacts can be made with quite low apparent density. Thus, the powder as supplied commercially has an apparent density of 2·4 to 2·5 grammes per cubic centimetre but it can be supplied in apparent densities as low as 1·6 or as high as 2·8 grammes per cubic centimetre. High purity is obtained by the process because there is no residual unreduced oxide, as in the sponge iron processes. The purity of the final powder is said to be in the region of 99·8 per cent Fe. The absence of silica eliminates the abrasive effect of that substance during compacting operations. The new material is expected to enter all the fields of application for which the present iron powders are suitable. It should prove of particular value where a high-purity material is required for low-density compacts, as in the field of electronics.

A Supercharger for Aircraft Engines

The General Electric Company, of Schenectady, New York, has developed a turbo-supercharger for use in conjunction with reciprocating engines of the latest designs. The new unit, designated the "CH 9," has been undergoing test bed operation in combination with a Pratt and Whitney "4360" piston engine, which is considered to be the most powerful conventional engine now in use in the United States. The tests showed a take-off boost of 32 per cent and a reduction in fuel consumption of 20 per cent. The "CH 9" supercharger supplies the engine with 350 lb of air per minute, at six times normal atmospheric pressure. The conventional gearing, operating off the engine shaft, has been eliminated in the design of the unit and there are no mechanical connections between the engine and the supercharger. The new product is expected to lead to improved trans-Atlantic flight performance of existing commercial airliners.

A Fish Screen for a Reclamation Pumping Plant

In order to protect salmon and striped bass in the Sacramento and San Joaquin Rivers of California, the Bureau of Reclamation is constructing an experimental fish screen near the intake of the large Tracy pumping plant. After extensive study of the possible effect which the operation of the pumping plant may have on fish life in the area, the experimental screen has been designed with a view towards testing and developing methods and equipment for preventing the entrance of fish into the intake channel of the plant, where they would be caught in the pumps. At the same time the screen will enable an accurate determination as to whether fish life exists in the intake channel to such an extent as to warrant elaborate conservation works. The screen across the pilot channel, which will be used in the first tests, will divert the fish into a holding basin, where they will be counted, then transported by barge downstream and returned to the river. The Tracy Pumping Plant is a key structure within the Central Valley Reclamation Project. It serves to lift water of the Sacramento River 197ft into the Delta-Mendota Canal, whence it flows southward, supplying the water-short lands along the San Joaquin River. Construction of the pumping plant building has been completed and the installation of pumps and motors is now in progress.

Association of Iron and Steel Engineers

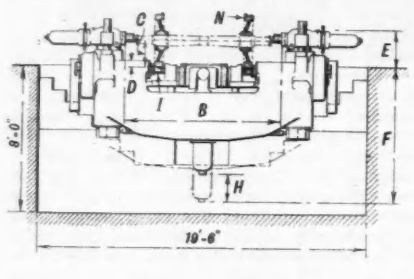
During the annual convention and exposition of the Association of Iron and Steel Engineers which was held at the Cleveland Public Auditorium last autumn, a total of forty-six papers were presented at fourteen technical sessions, and more than 150 suppliers of steel mill plant and equipment exhibited their products. The large size of steel works machinery generally precludes the showing of full-scale equipment, but such working and producing models as a 26in electric weld tube mill and a high-speed, five-stand cold strip mill proved to be interesting alternatives. Two items of auxiliary mill equipment were exhibited for the first time and are deserving of special mention. The General Electric Company, of Schenectady, New York, has developed an electronic width gauge for hot strip mills, which facilitates the adjustment of edging rolls to maintain widths to closer tolerances than had previously been considered possible. The gauge does not come into actual contact with the strip, but has two detector heads which respond to the illumination from the hot strip. The heads are mounted several feet above the strip, and when hot strip passes underneath, its actual deviation from the width set by the operator is recorded by two photo-electric cells and is translated into fractions of an inch on a deviation indicator. A permanent record of the width variation can be had by the addition of a paper tape recording device. In addition to making possible the production of hot strip of closer width tolerance, the new gauge can be instrumental in reducing the amount of scrap loss due to edge trimming. An interesting industrial application of television was exhibited by the Diamond Power Specialty Company, of Lancaster, Ohio. Its "Utiliscope" device is used to transmit a televised view of any factory scene and uses a 10in cathode-ray tube for receiving. Connection between transmitter and receiver is by means of wire or coaxial cable. The equipment is considered to be of special value in connection with the observation of processes too dangerous to be watched at close range.

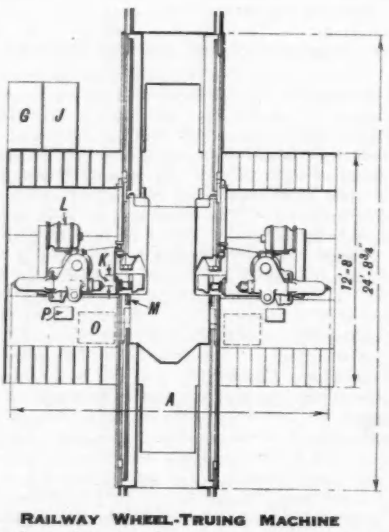
One of the papers presented at the technical sessions of the convention provided interesting

information on the extent of the use being made in the United States of tungsten carbide rolls for cold rolling of strip steel and non-ferrous metals. According to Mr. R. T. Beeghly, of the Metal Carbides Corporation, of Youngstown Ohio, more than fifty mills now have carbide rolls installed and, consequently, are able to take 10 to 20 per cent greater reductions per pass, at the same time requiring less power. The carbide rolls are said to outlast alloy steel rolls by more than fifty times when rolling low-carbon steel, and more than twenty-five times when rolling alloy and stainless steels.

A Railway Wheel-Truing Machine

The Standard Railway Equipment Manufacturing Company, of Chicago, has developed a wheel-truing machine, which, it is claimed, permits for the first time the restoration of full standard flange and tread contours of worn diesel locomotive wheels without removing either the bogies or the wheels from underneath the equipment. The machine, which is illustrated herewith, is a floating milling machine mounted on a universal joint and consisting of two individual main components. The first one is the milling unit, built up on a large floating C-shaped frame which weighs approximately 12 tons. This frame supports the cutters





RAILWAY WHEEL-TRUING MACHINE

and the tailstocks, or centres, which are set into the axle centres of the wheels being turned. The desired depth of cut is obtained by simultaneously raising the C-frame and lowering the tailstocks. Two 25 h.p. motors drive the cutter spindles at 106 r.p.m., the cutters being adjustably positioned underneath the wheels. The second portion of the machine is the driving mechanism, consisting of a dual set of sliding-rail sections, which holds the wheels to be milled firmly against knurled rollers bearing against the flanges, and which is designed to revolve the wheels at a constant speed of 6½in per minute during the milling operation. Experience showed that climb milling, or revolving the cutters in a direction opposite to that of the wheels being trued, produced the best overall results. Two operators are required, one working on each side of the machine.

The special cutters developed for use on this machine are believed to be the first successful attempt at contour milling in material of 400 to 500 Brinell hardness. Each of the two solid cutter bodies is bored to accommodate more than ninety carbide inserts, arranged in eight spirals to form the full wheel contour, as illustrated. The inserts are cylindrical, ½in in diameter and ½in thick. Since only $\frac{1}{32}$in of the insert protrudes above the cutter body, worn cutting surfaces are simply renewed by revolving the insert slightly to establish a new arc of contact. When one side of the insert has been completely dulled by a series of eight to ten such adjustments, the insert is reversed in the cutter and the second side is used similarly. All inserts are placed so as to have a negative rake angle of 6 deg. In operation, the locomotive is moved over the machine pit, the wheel-drive rollers are raised, and the pair of wheels to be trued is moved against them. The other pair of wheels on the bogie is wedged and locked to the rails to prevent movement of the bogie. The retractable rails are moved away hydraulically to allow for raising of the wheel-truing machine. Once the latter is in its operating position, the tailstock centres are engaged with the wheel axle centres. The wheel-drive rollers and the cutters start rotating, the depth of cut being adjusted by electrically operated feed screws. On completion of the machining operation, the machine is lowered, the rail sections are repositioned, the wedged wheels released and the locomotive is moved for the truing of the next pair of wheels. The overall time for a single pair of wheels on this machine is forty minutes, including a setting-up time of ten minutes, a cutting time on 42in diameter wheels of about twenty-five minutes for one cut, and a taking-down time of five minutes. For the majority of wheels it has been found that the operation can be completed in one cut. If the flanges are thin and a considerable amount of tread metal has to be removed to restore the flange section, two or more cuts may be required. The treads of both wheels on each axle are machined to the same size and concentric with their respective journals, to an accuracy of about 0·005in on the diameter.

Estes Power Station, Colorado

The first 15MW generating unit of the Estes power station of the Colorado-Big Thompson project of the Bureau of Reclamation was put into service on October 1st to meet the expanding electrical power requirements in the States of Colorado, Wyoming and Nebraska. This generator has been providing voltage regulation for the interconnected power system of the Bureau since September 17th, and will now provide reserve capacity during possible emergency conditions. A second unit of 15,000kW capacity is scheduled for operation on the same basis by November 1st, and installation of the third and final unit of 15MW capacity will be completed at the end of the year. Thus there will be available a total emergency reserve capacity of 45MW to be utilised during the peak load season. Full continuous power production from the Estes plant will not be achieved until two years from now, when the Granby reservoir is expected to be substantially full. Increasing amounts of electrical energy will become available during the next two years, until in 1953 the total capacity of the Colorado-Big Thompson project of nearly 175MW will be in operation with an average annual production of energy of approximately 650,000,000kWh.

Anglo-American Aircraft Engine Agreement

A long-term agreement calling for the exchange of existing and future products and continuing close collaboration, has been announced by Armstrong Siddeley Motors, Ltd., and the Wright Aeronautical Corporation, of Wood-Ridge, New Jersey. The agreement will make available to the United States the Armstrong Siddeley Sapphire turbo-jet engine, and Python, Mamba and Double Mamba turbo-prop power units. Among other products, the British company will manufacture the new range of Curtiss propellers, which are already in the trans-sonic speed range and are being developed for supersonic speeds. Manufacture of the British engines at the works of the Wright Aeronautical Corporation is to start immediately, and it is believed that several million dollars in licensing fees were paid by the American company.

French Engineering News

(From our French Correspondent)

Members of the Senate Defence Committee sent to examine the Maginot Line, have reported that the line is still usable. They say that the concrete is solid and the only repair necessary, apart from its re-equipment with modern arms, is to the ventilation system and a few minor details. Whilst the High Command is said to be doubtful about the efficacy of the line, the senators maintain that at relatively small cost it could be brought back into effective use.

* * *

A new steel group called the Union Sidérurgique Lorraine, is to be set up if the shareholders of the Forges et Aciéries de la Marine d'Homécourt, the Société des Aciéries de Micheville, the Société des Fonderies and the Compagnie de Pont-à-Mousson agree. The new group will be known as Sidemor and will unite the mills and mines of Homécourt and Micheville as well as mills and mines of Ronas, d'Auboue and the mine at Mairy.

The object of the amalgamation is to form a unit strong enough to carry out far-reaching modernisation and centralisation schemes. The Aciéries de la Marine will contribute, in addition to the Homécourt works, those of Haumont and Bordeaux.

* * *

The new laboratories of the Centre Technique de la Fonderie are nearing completion and will be ready for use next year. These laboratories will carry out tests on samples submitted by the whole industry and the new centre will also include a research bureau, which will be placed at the disposal of all foundries wishing to modernise. It is hoped that these new laboratories and bureaux will assist the French founding industry back to its pre-war level.

* * *

The French government has decided to import 600,000 tons of metallurgical coke and anthracite coal in order to meet the 1950-51 fuel deficit.

The metallurgical coke will not be delivered to France, however, because the steel industry has sufficient fuel on hand. 100,000 tons will be sent to Holland for use in mills in which the French have interests and have undertaken to keep supplied with coke. Some 200,000 tons will be sent to North Africa. The remaining 300,000 tons, as well as 100,000 tons of coal for domestic use, will be stocked in France to be used as and when required. The fuel will be paid for with free dollars from the stabilisation funds and the expenditure will be compensated by the sale of steel to the United States.

At the moment no steel is being sent to the U.S., although the Americans are willing to buy all the steel they can obtain. It is expected, however, that as production improves and the armaments programme gets under way, there will be sufficient steel to allow some export. At the same time, modernisation of the French industry will mean a greater demand for fuel and there is some fear that early in 1951 there may be a shortage of metallurgical coke. The stocks of American coke now being laid down will meet the demand for a time, but the French insist that the only solution to their problem is a greater import of coke from Germany.

* * *

Work on the Paris-Le Havre pipe-line is expected to commence shortly, following agreements between French oil companies and a number of landowners through whose property the pipe-line will pass.

The line will be 50km long and will have a capacity of 1,500,000 cubic metres of fuel per year. At Le Havre four pumping stations will be set up, while in Paris there will be twelve terminals, seven in the north and five in the south of the city. These terminals will serve twenty-two distribution depots.

For the construction of this line, material from a pre-war project between Donges and Montargis will be used. The cost of construction of the line is now estimated at about £2,000,000.

Industrial and Labour Notes

Increasing Industrial Productivity

In his statement at the annual general meeting of Herbert Morris, Ltd., on Friday last, December 8th, the chairman, Mr. Frank Morris, expressed the view that one of the outstanding features of the year in the industrial field had been the steady flow of reports from teams which had visited the U.S.A. under the auspices of the Anglo-American Council on Productivity. Throughout nearly all the reports, he observed, there ran the same theme of "productivity consciousness" of both management and workers in American industry.

Mr. Morris thought it was unquestionable that the main problem facing this country was primarily one of more efficient utilisation of the available resources. Clearly, he said, in view of the additional commitments for the country's rearmament programme, industry could expect little or no increase in the available equipment or labour force. But, he emphasised, the country's need for increased productivity was urgent, and it therefore followed that management and men must co-operate with vigour and determination to study existing methods of work and improve them, and maybe, by arranging things differently, enable jobs to be done with less effort and more efficiently. One of the most interesting reports on productivity, Mr. Morris considered, was that issued independently by the Trades Union Congress.

It was pleasing to note, Mr. Morris continued, that the members of the T.U.C. team advocated that trade unionists should co-operate in the application of scientific methods, and seek to increase productive efficiency through a greater use of mechanical aids and the application of time and motion studies in order to maximise earning opportunities. It was to be hoped, he said, that those recommendations of their leaders were accepted by trade union members as being in their own interests as well as being a national requirement.

Non-Ferrous Metals

Last week, in Parliament, the Minister of Supply, Mr. Strauss, was asked to make a statement about metal shortages, and to say what steps were being taken to ensure that available supplies were distributed to the best advantage. In a written reply, the Minister said that the world shortage of some metals was due, basically, to the effects of the international situation and, in particular, to the increased demands in many countries for rearmament and stockpiling. Measures of alleviation were under discussion internationally and his department was making every effort to increase supplies; but some shortages were inevitable in view of present world conditions.

The Government had now decided, the Minister continued, to take further steps to ensure the proper distribution in the national interest of those metals of which there was a severe shortage. The measures being considered in consultation with industry included restrictions on the export of semi-manufactures, the prohibition of the end uses of such metals for non-essential articles, and the institution of allocation systems. The statement then went on to deal with the supply prospects of metals at present causing most concern. It explained that supplies of all grades of zinc available to industry over 1951 as a whole would involve further cuts in consumption, and out of the amount available the increasing requirements of defence would have to be met. The position was likely to be even more serious during the first quarter of the year, and, though every effort was being made to avoid it, the Minister intimated that the supply of ordinary grade zinc might have to be restricted during the first quarter to little more than 50 per cent of the rate of consumption in the first nine months of 1950. Referring to copper, the Minister said that a severe shortage of certain special shapes would affect particular fabricators, and for the rest the prospects were that in the early months of 1951 supplies would not allow of consumption at a higher rate than in the first half of 1950. That represented a cut of about 10 per cent on the current rate of consumption. About aluminium, the Minister forecast that supplies of virgin metal, which had been running at about 17,000 tons a month, would have to be restricted next year to 15,000 tons a month, out of which the substantially increasing demand for defence would have to be met.

At the beginning of this week the British Non-Ferrous Metals Federation commented on the Minister's statement, saying that the prospective shortages of copper and zinc, if not rapidly alleviated, must result during the next few months in widespread redundancy of labour and in a serious decline in production in all metal making and using industries. The Federation also commented on the Minister's reference to consultation with industry, and reaffirmed its keen desire to co-operate in devising and implementing effective means of minimising the disaster. But the Federation felt it desirable to put on record the view, widely held in industrial circles, that if the Minister had in the past followed a more imaginative purchasing policy, as private industry would have done, the position would not now be so grave.

Steel Supplies

The statement by the Minister of Supply, referred to in the preceding note, contained a comment on steel prospects. It said that, at present, there was no real shortage of general steel, but steel production next year might be affected by difficulties in supplies of raw materials, particularly imported scrap and imported iron ore. The Minister expressed the hope that those difficulties could be overcome; but, if not, he said, it seemed possible that the 1950 level of steel output might not be achieved in 1951. No improvement in supplies of steel sheet or tinplate could be expected until the new plant in South Wales came into production in the latter part of next year.

Europe's Iron and Steel Industry

The Steel Committee of the United Nations Economic Commission for Europe has just concluded its seventh session, which was attended by delegates from sixteen countries, including the United Kingdom and the U.S.A. The Committee, it is stated, reached the conclusion that the achievement of planned increases in 1951 of about 21 per cent in European pig iron production and of 14 per cent in crude steel production, over this year's output, is not expected to run into insuperable difficulties so far as raw materials are concerned, provided three conditions are met. Those conditions are: capacity production of coke, iron ore and scrap; a satisfactory flow of trade in these materials; and their rational use.

Whilst calling for maximum output of coke, iron ore and scrap, and for economy in their use in order to meet requirements of capacity iron and steel production, the Committee was "keenly aware" that local shortages might arise. Those risks, it acknowledges, are inherent in the situation where raw materials in short supply have to be traded between twenty-four European iron and steel producing countries, each of which is dependent on imports for covering at least part of its requirements of one of the main steelmaking raw materials. The Committee agreed that international action was needed to ensure adequate supplies during the coming year. It is therefore urging the Commission's Coal Committee to seek a means of achieving a satisfactory level and pattern of trade in coke and coking fines. It also decided to recall its panel of experts on scrap to suggest methods of increasing scrap supplies. Furthermore, it recommended technical adjustments in blast-furnace charges to conserve very scarce materials, and, looking ahead to a more serious shortage of iron ores in 1953, called for an expert study of measures by which adequate supplies might be ensured.

Census of Production Arrangements

The Board of Trade has made an Order indicating the scope of the Census of Production which is to be taken in 1951 in relation to the year 1950. It states that undertakings which are wholly or mainly engaged in building and civil engineering contracting are excluded from the Census, and that undertakings producing coal, gas, electricity, oil shale, crude or refined petroleum or shale oil products are exempted from making returns to the extent to which they supply the necessary information to the Minister of Fuel and Power. The title of the Order—which operates from December 30th next—is the Census of Production (1951) (Scope, Returns and Exempted Persons) Order.

The Board of Trade also announces that it has appointed the statutory Advisory Committee to advise it when considering the preparation of forms and instructions for the Census of Production to be taken in 1952. Mr. J. Stafford is the Chairman of the Committee.

T.U.C. Training Courses

The Trades Union Congress has announced the first of two full-time training courses designed to help trade union representatives to gain wider knowledge of technical problems which crop up increasingly in joint negotiations and consultation. Subjects in the syllabus include work study, costing, and factors in industrial efficiency, and the lecturers will be drawn from the T.U.C.'s specialist staff, assisted by outside experts who have had experience of industrial consultation and who are able to discuss from a trade union angle any problem of production and management likely to be of interest to those taking the courses. The first training course will last from February 5th to 9th next, and the second is to begin on March 12th. This new service, the T.U.C. says, follows the approval given to a decision of the General Council to provide training courses as a positive contribution by the trades unions to industrial efficiency.

"Good Housekeeping" in Factories

The Royal Society for the Prevention of Accidents is organising a national "good housekeeping" week for British industry from April 2 to 7, 1951. It says that the object is twofold: to enlist the support of all employers and employees in securing tidiness and cleanliness in the workshop—both invaluable factors in reducing accidents; and to provide an opportunity for a general spring-cleaning of British factories in readiness for the Festival of Britain.

A programme of suggested activities is being drawn up and the Society is preparing special publicity material, including a booklet for distribution to factory workers. The Society's Industrial Accident Prevention Groups are assisting in the work of local organisation. Further information about the matter can be obtained from the Royal Society for the Prevention of Accidents, Terminal House, 52, Grosvenor Gardens, London, S.W.1.

Coal Production

The report by the Ministry of Fuel and Power on last week's coal output shows that the amount raised from the deep mines was 4,392,200 tons, and from opencast workings 163,900 tons, giving a total for the week of 4,556,100 tons, compared with 4,513,100 tons in the preceding week. Last week's production, however, was below that achieved in the corresponding week a year ago. Total manpower on colliery books in the week ended December 2nd was 686,700, of whom 284,200 were face workers. The output per manshift at the face in that week was 3·21 tons, compared with 3·17 tons in the week ended November 25th.

Personal and Business

MR. R. G. LEDGER and Mr. K. F. Dormer have been appointed directors of Mackay Industrial Equipment, Ltd., Feltham, Middlesex.

THE AEROGRAPH COMPANY, Ltd., Lower Sydenham, S.E.26, states that Mr. L. Gaiger has been appointed sales manager and Mr. John Muirhead assistant sales manager.

MR. C. S. GILL, managing director of Davy and United Roll Foundry, Ltd., has been re-elected chairman, for the fifth successive year, of the Roll Makers' Association of Great Britain.

CROMPTON PARKINSON, Ltd., announces the following appointments: Mr. L. C. W. Turner, manager of the plant division, Manchester, and Mr. A. G. Graham, A.M.I.E.E., manager at Belfast.

SIR ALEXANDER CADOGAN, G.C.M.G., has been nominated by the Prime Minister for appointment as Government director of the Suez Canal Company, in succession to the Earl of Cromer, who is resigning.

STRAMIT BOARDS, Ltd., Cowley Peachey, near Uxbridge, announces the appointment of Mr. J. S. Hewitt, Ravenswell House, Lansdowne, Bath, as technical representative for S.W. England and South Wales.

THE BRITISH ELECTRICITY AUTHORITY announces the appointment of Mr. L. W. Stretton, M.I.E.E., as chief generation engineer (operation) of the Eastern Division, in succession to Mr. A. C. Thirtle, A.M.I.C.E., A.M.I.E.E., who has become divisional controller of the South Western Division.

KIRK AND CO. (TUBES), Ltd., has appointed Mr. K. Worth, "Kendor," Longford Road, Neath, as agent for South and Central Wales and Herefordshire, and Mr. D. J. Hudson, 39, York Road, Edgbaston, Birmingham, as agent for Shropshire, Staffordshire, Warwickshire and Worcestershire.

Contracts

THE HUNSLET ENGINE COMPANY, Ltd., Leeds, has received an order for four special narrow-gauge, straight-diesel locomotives for the Sudan. They will be 0–8–0 equipments, with engines of 120 b.h.p. at 1000 r.p.m. for 1200ft altitude and 120 deg. Fah. temperature. Top speed is to be 20 m.p.h., maximum tractive effort 7600 lb, total weight 17½ tons.

THE BRITISH ELECTRICITY AUTHORITY placed contracts during November, for equipment for power stations, transforming stations and transmission lines amounting in the aggregate to £1,464,029. The principal contracts include: Meaford power station, near Stoke-on-Trent, 132kV transformers (British Thomson-Houston Company, Ltd.); Keadby power station, Lincs., 415V switch and contactor gear (Contactor Switchgear, Ltd.), and structural steelwork (Appleby-Frodingham Steel Company); Northampton power station, circulating water pipes, inlet dock, pumphouse and other works (Holloway Bros. (London), Ltd.); Roosecote power station, Barrow-in-Furness, steel frame for turbine house and boiler house buildings (Dorman Long and Co., Ltd.); Nechells "B" power station, Birmingham, 11kV 1000MVA switchgear (General Electric Company, Ltd.).

Catalogues

W. SISSON AND CO., Ltd., Gloucester.—Catalogues describing Sisson steam engines and Sisson forced lubrication enclosed steam engine.

THE UNITED STEEL COMPANIES, Ltd., 17, Westbourne Road, Sheffield, 10.—Brochure entitled "Some Notes on Alloy Steels Containing Lead."

BRITISH TIMKEN, Ltd., Duston, Northampton.—Service manual No. 1500, entitled "Timken Service Data for Automotive Equipment."

SOAG MACHINE TOOLS, Ltd., Juxon Street, Lambeth, London, S.E.11.—Leaflet describing the "Excelsior" roller multiple punching press, No. 3.

THE ELECTRICAL APPARATUS COMPANY, Ltd., St. Albans.—Leaflet No. 150, describing E.A.C. flameproof starter switchboards and switch fuses.

BRITISH JEFFREY-DIAMOND, Ltd., Stennard Works, Wakefield, Yorks.—Catalogue No. 1477, dealing with B.J.-D. longwall scraper chain conveyors.

AUTOMATIC TELEPHONE AND ELECTRIC COMPANY, Ltd., Strowger House, Arundel Street, London, W.C.2.—Booklet on radio and electronic products.

GASTON E. MARBAIX, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11.—Brochure dealing with "Barneadril" magnetic coolant separators.

STURTEVANT ENGINEERING COMPANY, Ltd., Southern House, Cannon Street, London, E.C.4.—Illustrated booklet dealing with heating and ventilation.

THE HOWARD PNEUMATIC ENGINEERING COMPANY, Ltd., Fort Road, Eastbourne, Sussex.—Booklet describing "John Bull" petrol-driven railway track maintenance equipment.

Notes and Memoranda

Rail and Road

ROAD RESEARCH LABORATORY.—The Department of Scientific and Industrial Research states that Dr. A. R. Lee, A.R.C.S., D.I.C., F.Inst.P., has been appointed a Deputy Director of Road Research. His duties will concern research on materials and methods of construction of roads and he will have the rank of deputy chief scientific officer. By this appointment the two sides of the work at the Road Research Laboratory, D.S.I.R., will each have a deputy director responsible to the Director of Road Research. Dr. R. J. Smeed, the other deputy director, is concerned with the work of the safety and traffic division.

A BRITISH RAILWAYS STAFF TRAINING SCHEME.—The Railway Executive has introduced a scheme for training in commercial, operating, and motive power work, to assist men under twenty-eight years of age to qualify for consideration for promotion to higher administrative and executive posts. Under this scheme a selection board will make appointments from staff candidates who pass satisfactorily a preliminary written examination, conducted by a recognised educational examining body. Selection will also be made from candidates who are either graduates of a British university or are suitably qualified ex-regular officers of H.M. Forces. The majority of trainees will be selected from the staff and appointment will not depend entirely upon the examination, nor upon academic attainments in the case of university graduates, as suitability in other directions will play a considerable part in selection. During the three-year training period the phases of work which will be covered include small and large passenger and goods stations, control offices, district headquarters offices (operating, motive power and commercial), staff work and contacts with technical departments to the extent necessary. About 2500 railwaymen sat recently for the first examination to be held in connection with this scheme and the final selection will be made from about 120 of this number.

Air and Water

UNITED NATIONS' HOSPITAL SHIP.—The motor vessel "Jutlandia," which was built by Nakskov Skibsvaerft Akt and engined by Burmeister and Wain in 1934 for the East Asiatic Company, Ltd., has been returned to her builders for conversion into a hospital ship for the United Nations. When completed the vessel, which has a length of 437ft and a speed of 15 knots, will be equipped with three operating rooms and 250 beds in four wards.

A LARGE OPPOSED-PISTON OIL ENGINE.—Successful trials of a large opposed-piston airless injection oil engine have been held by Barclay Curle and Co., Ltd. This Barclay Curle-Doxford engine has six cylinders of 750mm diameter by 2500mm combined stroke, and is designed to develop 8000 b.h.p. at 104 r.p.m. On the test bed the designed brake horsepower and revolutions per minute were realised at a mean indicated pressure of 85·4 lb per square inch and the mechanical efficiency was 88·4 per cent. The engine is to be installed in the Norwegian oil tanker "Polarbris," of 18,500 tons deadweight, which is being built by the company.

Miscellanea

MR. PERCY GOOD.—A memorial service for the late Mr. Percy Good, Director of the British Standards Institution, will be held at St. Martin-in-the-Fields, Trafalgar Square, W.C.2, at 12.15 p.m., on Monday next, December 18th.

MACHINING OF COPPER AND ITS ALLOYS.—When reporting the first meeting of the P.E.R.A. Electrical Equipment Manufacturers' Advisory Panel, in our issue of November 24th, it was stated that "difficulties were being encountered in machining copper . . ." The Copper Development Association has since drawn our attention to its publication, No. 34, "The Machining of Copper and its Alloys," which gives much valuable and interesting data on the subject in question. This book can be obtained free of charge from the Association's offices, Kendals Hall, Radlett, Herts.

WATT PUMPING ENGINES TO BE DISMANTLED.—The pumping engines at Whitacre, Birmingham, built by James Watt and Co., in 1884, are now being dismantled for scrap by John Cashmore, Ltd., of Tipton. The two vertical compound beam differential steam engines were built in 1884, with control gears by Hathorn Davey and Co., Ltd., of Leeds, and were used for driving single-acting ram pumps, pumping water from Shustoke to Birmingham. Each engine was capable of pumping 6 million gallons of water per twenty-four hours against a total head of 260ft at a working steam pressure of 70 lb per square inch. Both the engines and pumps are of massive proportions, the engines standing 26ft high above the engine house floor and the pumpwork extending 34ft below floor level. The high-pressure cylinders are 33in diameter, and the low-pressure cylinders 60in diameter, with a stroke of 10ft, driving two 26in diameter single-acting pump rams at ten strokes a minute.

POWER STATION EXTENSIONS AT CARMARTHEN BAY AND COWES.—Consent of the Minister of Fuel and Power has been received by the British Electricity Authority for extensions of the new power station at Carmarthen Bay, South Wales, and the power station at Cowes, Isle of Wight. The authorisation covers the installation of two turbo-alternator sets, each of 60MW, and nine boilers, each of an evaporative capacity of 240,000 lb per hour, at Carmarthen Bay, and one 12·5MW set and one boiler, of an evaporative capacity of 135,000 lb per hour at Cowes.

ROYAL SHOW, 1951.—At the annual meeting of the Royal Agricultural Society, held in London on December 6th, it was stated that 520 provisional applications for trade stands at next year's Royal Show at Cambridge had already been received. The annual report says that the Council of the Society has several times considered the possibility of abandoning the itinerant system for the Royal Show, in favour of one or more permanent sites. Detailed information is being prepared on the financial and other aspects involved and on the possibilities of a permanent site or a series of semi-permanent sites.

ENGINEER BUYERS' AND REPRESENTATIVES' ASSOCIATION.—The first annual luncheon of the Engineer Buyers' and Representatives' Association was held in London on Thursday, December 7th. In a speech following the luncheon, Sir Patrick Hannon dealt at some length with the heavy burden of taxation imposed on British industry and the effect it was having. No industry could stand such high taxation indefinitely and its effect on costs made competition with the more lightly taxed American-produced goods very difficult, particularly in overseas markets. Mr. J. H. Cole, the vice-chairman of the London branch of the Association, spoke of its growth during the past two years and the successful way in which it was bringing buyers' and sellers' representatives together to the benefit of both parties.

A CENTENARY.—A centenary souvenir, in the form of an illustrated booklet, has been produced to commemorate the hundredth birthday of Fisher and Ludlow, Ltd., Great Britain and Canada. During the second World War this firm lost on the night of December 2, 1940, fourteen of its factories and all historical records and data perished. To compile this booklet Fisher and Ludlow had first to reconstruct its history and a meeting was convened of the oldest servants, who recorded on a sound track their own personal recollections of associations with the firm. The booklet includes many artists' impressions of the original plant, and coloured prints depict a wide field of its present activity at the new site, the Albion Works, Castle Bromwich, Birmingham, which covers an area of 103 acres. Included is a recovered German photo-reconnaissance picture taken before the war, on which the Fisher and Ludlow factories were pinpointed as Class A targets.

THE LATE MR. FREDERICK PEEL.—We have learned with regret of the death of Mr. Frederick Peel, director and chief engineer of W. J. Fraser and Co., Ltd., which occurred suddenly at his home at Upminster, on Wednesday, December 6th. Mr. Peel was born on January 21, 1887, and received his technical education at the Marine School, South Shields, and Sunderland Technical College. He served an apprenticeship of six years in the shipbuilding and engineering shops of John Readhead and Sons, South Shields, and then served three years in the Mercantile Marine, rising to Chief Engineer. He was Premier Silver Medallist in Mechanical Engineering, City and Guilds Institute, Premier Prizeman of Goldsmiths' Institute, and National Prizeman in Machine Design, Board of Education. He obtained the Extra First-Class Engineers' Certificate under the Board of Trade. He joined W. J. Fraser and Co., Ltd., Dagenham, in 1913, and was appointed a director in 1938. Mr. Peel was one of the earliest members of the Institution of Chemical Engineers and was a member of the Institute of Marine Engineers. He was also a member of the British Standards Institutions main committee on pressure vessels.

British Patent Specifications

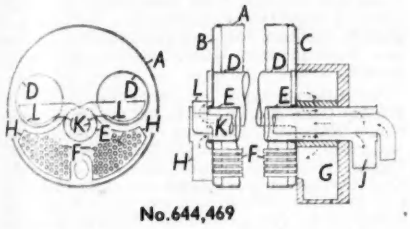
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

STEAM GENERATORS

644,469. December 20, 1948.—IMPROVEMENTS IN FIRETUBE STEAM BOILERS, George Kerfoot, 121, Lodge Lane, Hyde, Cheshire.

In the steam boiler described an improvement is effected by incorporating an additional circular metal return flue in the water space of the boiler, so that the flue gases after leaving the firetubes will pass through this metal return flue and give up additional heat to the boiler water. An air heater can be placed inside the metal return flue so that the flue gases simultaneously give up heat to the boiler water and the combustion air. The metal return flue, which is surrounded by water, may be placed above or below the horizontal centre line of the boiler. Referring to the accompanying drawings, it will be seen that the boiler consists of a cylindrical shell *A* with front end plate *B* and back end plate *C*, furnace flues *D* and the return flue *E*. Nests of firetubes *F* are disposed below the furnace flues. A brick-lined combustion chamber *G* is connected to the back of the boiler and a front metal box *H* is attached to the front end

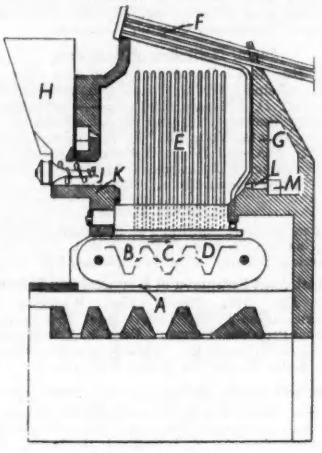


No.644,469

plate. An outlet flue *J* is connected to the metal return flue. The products of combustion after leaving the furnace flues *D* enter the combustion chamber *G*, change direction and then pass through the firetubes *F* into the front box *H* and from the latter through the circular metal return flue *E*, which is surrounded by water and, finally, to the outlet flue *J*, where a connection is made to an induced-draught fan or chimney. An air heater *K* can be fitted in the metal return flue *E*. With an air heater fitted, the products of combustion after leaving the firetubes *F* pass from the front box *H* into the annular space between the air-heating tube *K* and the metal return flue *E* and finally to the outlet flue *J*. The combustion air to be heated is forced, by a fan, in the opposite direction through the air heater *K* into the air box *L* and from the latter to the underside of the firegrate. In a modified construction the nests of firetubes are disposed above the furnace flues and the circular metal return flue is set between the nests of firetubes.—*October* 11, 1950.

644,241. July 13, 1948.—IMPROVEMENTS IN OR RELATING TO COMBUSTION APPARATUS, Babcock and Wilcox, Ltd., of Babcock House, Farringdon Street, London, E.C.4 (*communicated by Deutsche Babcock and Wilcox Dampfkesselwerke Aktiengesellschaft, Oberhausen, Rhineland, Germany*).

This invention relates to combustion apparatus of the kind in which the fuel is subjected to preliminary drying by radiation within the combustion chamber. In the drawing a travelling or chain grate *A* is formed with three compartments *B*, *C* and *D*, arranged in suitable manner for control of the air supply to the grate. The grate is provided for firing the combustion chamber *E* of a vapour generator including a horizontally inclined vaporising tube bank *F*, arranged above the combustion chamber. The rear wall *G* and the side walls of the combustion chamber are lined with tubes. From a hopper *H* the fuel passes to feed worms *J*, which convey the fuel into the combustion chamber, at the same time turning the fuel over in the worm trough *K* and exposing it to radiation within the combustion chamber, as a result of which the fuel is pre-dried. From the worm trough the fuel falls down the front wall of the combustion chamber on to the receiving end of the grate. The fuel ignites in part in the worm trough and in part on the receiving end of the grate, and air supplied at high pressure through compartment *C* to the intermediate zone of the grate above that compartment is therefore able, notwithstanding the shortness of the intermediate zone, to complete the main combustion of the fuel in that zone. In order to complete the main combustion relatively rapidly and on the short intermediate zone of the grate, a total pressure at the fan supplying the compartment *C* of at least 7¼in water gauge is required. During operation, the air pressures in the compartments *B* and *D* are set to suitable values, after which control of the air supply to the grate for the purpose of regulating the output of the vapour generator is effected by controlling the air supply to the compartment *C*. With an appreciably long zone of final combustion the furnace gases from above



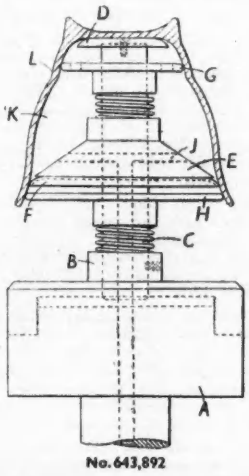
No.644,241

that zone are preferably mixed with the furnace gases above the main combustion zone. To this end air nozzles *L* are provided in the rear wall *G* and are supplied with secondary air from the duct *M*. In practice the whole of the primary and secondary air may be supplied by a common high-pressure fan, the relatively small volumes of air required for the initial and final combustion zones being obtained by throttling. In the case of a large combustion chamber, however, separate fans may be provided. For example, one fan may be provided for supplying secondary air at the highest pressure, a second high-pressure fan supplying air to the main combustion zone and a third relatively low-pressure fan supplying air to the initial and final combustion zones.—*October* 4, 1950.

MISCELLANEOUS

643,892. November 14, 1947.—IMPROVEMENTS IN AND RELATING TO CHUCKS, F. Malkin and Co., Ltd., Maurice Whiston Abberley and Arthur Godfrey Ellis, all of Chadwick Street, Longton, Stoke-on-Trent.

This invention relates to chucks, for holding articles of clay, glass, plastics or other materials, in manufacture or finishing operations. The chucks are for articles having one end closed and the other end open and have flexible means for forming an air sealed closed cavity within the article and means for exhausting the cavity. In one of two alternative forms of potters' chuck described,

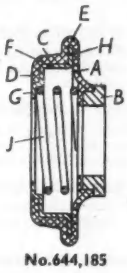


No.643,892

a spindle has screwed on to it a boss *A*. A collar screwed on to this boss has a boss *B* by which it is fastened on to a chuck spindle *C* by means of grub screws. A fixed locating disc *D* is secured to the end of the spindle. A seal carrier comprising a boss and conical part *E* is also fixed on the spindle. The conical part carries a flexible disc *F*. Between the seal carrier and the end stop a perforated locating disc *G*, mounted on the spindle, is free to move axially along the spindle under the control of a spring. A similar locating disc *H* having a control spring is mounted on the spindle below the seal. A duct along the spindle communicates with passages *J* on the upper face of the cone *E*. When a suction connection is applied, air will be exhausted from the cavity *K* when a clay piece *L* is fitted on to the chuck, the suction acting on the marginal part of the flexible disc *F* and causing it to make an air-tight seal against the inside walls of the piece. The piece is thus held in position by the vacuum and is correctly located and centered by the two discs, *G*, *H*. The number and the position of the locating and centering discs depends on the shape of the piece.—*September* 27, 1950.

644,185. May 25, 1948.—IMPROVEMENTS RELATING TO GLAND PACKINGS FOR USE BETWEEN RELATIVELY ROTATABLE PARTS, Super Oil Seals and Gaskets, Ltd., of Birmingham Factory Centre, King's Norton, Birmingham, 30. *Inventor*, Edgar Charles Jordan.

This invention is intended to provide an improved gland packing for use with rotary pumps, or for other analogous purposes, the packing being of the kind required to prevent leakage of fluid between a pair of relatively rotatable end faces. Referring to the drawing, the rubber or like diaphragm *A* has incorporated a hard sealing ring *B*. The outer periphery of the diaphragm is extended to form a short cylindrical peripheral portion *C*, which at the end remote from the diaphragm is shaped



No.644,185

to form an inwardly extending flange *D*. At the end adjacent to the diaphragm the part *C* is shaped to form a narrow outwardly extending flange *E*. Within the peripheral portion is placed an annular sheet metal reinforcing member comprising a peripheral part *F*, and end flanges *G*, *H* corresponding to the flanges of the rubber housing. The rubber part closely embraces the reinforcing member and may be bonded to it. The spring *J* abuts at one end against the inner side of the diaphragm adjacent to the sealing ring and at the other end against the inwardly extending flange *G* of the reinforcing member.—*October* 4, 1950.

644,029. June 6, 1947.—AQUEOUS COOLING SOLUTIONS FOR USE IN THE MACHINING OF METALS, Lubrefor, 3, Rue Montgolfier, Pantin (Seine Department), France.

In order to obtain a satisfactory cooling liquid for tools when machining metals the inventors state that it is necessary, first, to correct the wetting power of the water by the addition of a wetting agent. Amongst a great number of substances tried by the inventors, butyl alcohol has been chosen and may be used in any concentration between 1 per cent and its concentration of saturation in water which is about 6 per cent. Secondly, it is necessary to prevent rusting of the machines and parts by the water. For this reason there is added to this aqueous butyl alcohol solution sodium orthophosphate or one or more metallic nitrites or both. These substances are effective from a concentration of 2 grammes per litre. Thirdly, the moving parts must be lubricated. With this end in view the aqueous solution is admixed with a soap, e.g., one derived from sodium or potassium hydroxide or from an amine. Particularly good results are obtained by using castor or linseed or coconut-oil base soaps. The soaps prepared from such oils have little tendency to flocculate in the presence of metallic salts, so that concentrated solutions containing one or more of these soaps in the presence of metallic nitrites can be prepared, whilst other types of soaps form a flocculation in the presence of metallic nitrites in concentrated solutions. If it is preferred to prevent any flocculation, a soap having a different cation to that of the metallic salt or salts added to the mixture should be used. A number of examples of compositions suitable for use as cooling solutions are given.—*October* 4, 1950.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

Association of Supervising Electrical Engineers

Mon., Dec. 18th.—CENTRAL LONDON BRANCH: St. Ermin's Hotel, London, S.W.1, "Oil Switchgear Failures and Their Causes," N. Elliott, 6.50 p.m.

Tues., Dec. 19th.—Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, "Modern Methods of Generation," J. H. Beard, 6.30 p.m.

Wed., Dec. 20th.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "Principles of Organisation," D. V. Burling, 7.30 p.m.

British Institution of Radio Engineers

To-day, Dec. 15th.—LONDON SECTION: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, discussion, "Progress in Loudspeaker Design," opened by R. L. West, 6.30 p.m.

Engineers' Guild

To-day, Dec. 15th.—YORKSHIRE BRANCH: Royal Victoria Station Hotel, Sheffield, speaker, J. R. Rylands, 7 p.m.

Illuminating Engineering Society

Wed., Dec. 20th.—TEES-SIDE GROUP: Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "Acrylic Plastics in Lighting," P. Collins.

Incorporated Plant Engineers

Mon., Dec. 18th.—YORKSHIRE BRANCH: The University, Leeds, "The Practical Side of Steam Storage," W. Goldstern, 7.30 p.m.

Tues., Dec. 19th.—GLASGOW BRANCH: Engineering Centre, 351, Sauchiehall Street, Glasgow, "Refrigeration and Some Industrial Applications," P. D. Cowell, 7 p.m.

Institute of Industrial Supervisors

Thurs., Dec. 21st.—ROTHERHAM SECTION: College of Technology, Howard Street, Rotherham, Members' Discussion Night, 7.30 p.m.

Institute of Navigation

To-day, Dec. 15th.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, "Psychological Aspects of Instrument Presentation," H. P. Ruffell Smith, 5 p.m.

Institute of Petroleum

Wed., Dec. 20th.—STANLOW BRANCH: Grosvenor Hotel, Chester, Apparatus Symposium, with Demonstrations, 7.15 p.m.

Institute of Refrigeration

Tues., Dec. 19th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "The Dehydration of Refrigeration Components," A. O'B. Brandon, 5.30 p.m.

Institute of Road Transport Engineers

To-day, Dec. 15th.—S. WALES GROUP: Institute of Engineers, Park Place, Cardiff, "Recent Developments in Rear Axles," T. R. Beady, 7 p.m.

Mon., Dec. 18th.—MIDLANDS CENTRE: Crown Inn, Broad Street, Birmingham, "Welding in Vehicle Maintenance and Repair," G. Mackenzie Junner, 7.30 p.m.

Thurs., Dec. 21st.—N.E. CENTRE: Hotel Metropole, Leeds, "Transport Law," H. Mann, 7 p.m.

Institution of Civil Engineers

To-day, Dec. 15th.—YORKSHIRE ASSOCIATION: Electricity Buildings, Hull, "A Full-Scale Experiment in Bog Blasting on Road Construction," J. S. K. Dalzell, 6.15 p.m.

Tues., Dec. 19th.—Great George Street, Westminster, S.W.1, Unwin Lecture, "Research and Developments in Prestressing," R. H. Evans, 5.30 p.m.

Institution of Electrical Engineers

Mon., Dec. 18th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2, discussion on "Have Post-War Broadcast Receivers Taken Full Advantage of Wartime Development," opened by R. B. Armstrong, 5.30 p.m.

Tues., Dec. 19th.—SCOTTISH CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "The Cost and Efficiency of Earthing on Low and Medium-Voltage Overhead Line Systems," L. Gosland, 7 p.m.

Wed., Dec. 20th.—SUPPLY SECTION: Savoy Place, Victoria Embankment, W.C.2, "The Design and Performance of Surge Diverters for the Protection of Alternating-Current Systems," T. F. Monahan, 5.30 p.m.

Institution of Engineers and Shipbuilders

Tues., Dec. 19th.—39, Elmbank Crescent, Glasgow, "Blast-Furnace Slag Building Materials," T. W. Parker, 6.30 p.m.

Institution of Mechanical Engineers

To-day, Dec. 15th.—Storey's Gate, St. James's Park, S.W.1, "Naval Gearing—War Experience and Present Development," J. H. Joughin, 5.30 p.m.——SOUTHERN BRANCH GRADUATES' SECTION: R.A.E. Technical College, Farnborough, "The Development of Armoured Fighting Vehicles Over the Last Twenty-five Years," D. D. Rycroft, 6.30 p.m.

Mon., Dec. 18th.—DERBY A.D. CENTRE: Midland Hotel, Derby, "Partnership," E. A. Evans, 7.15 p.m.——SCOTTISH A.D. CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "Post-War Public Service Vehicle Maintenance," T. H. Parkinson, 7.30 p.m.

Wed., Dec. 20th.—N.E. A.D. CENTRE: The University, Leeds, "Partnership," E. A. Evans, 7.30 p.m.

Thurs., Dec. 21st.—MIDLAND BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham, "Afghanistan—an Illustrated Lecture Making Special Reference to the Engineering Possibilities of that Country," W. Abbott, 5.45 p.m.

Institution of Mining and Metallurgy

Thurs., Dec. 21st.—Geological Society, Burlington House, W.1, "Engineering Review of Silicosis Prevention," J. T. McIntyre; "A Method for the Preparation of High-Purity Indium Metal," T. A. A. Quarm, 5 p.m.

Institution of Works Managers

Mon., Dec. 18th.—GLASGOW BRANCH: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "Budgetary Control," 7.15 p.m.

Junior Institution of Engineers

To-day, Dec. 15th.—Royal Society of Arts, John Adam Street, Adelphi, W.C.2, "Research and the Marine Engineer," D. J. Hoare, 7.30 p.m.——SHEFFIELD AND DISTRICT SECTION: Grand Hotel, Sheffield, "The Right Spring for Your Job." E. R. Squire, 7.30 p.m.

Fri., Dec. 29th.—39, Victoria Street, London, S.W.1, Film Evening, "Distinguished Company," "Wonder Jet," "Once Upon a Time," 6.30 p.m.

Newcomen Society

Wed., Dec. 20th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Manufacture of Vertical Boilers," John L. Coltman, 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Dec. 15th.—Neville Hall, Westgate Road, Newcastle-upon-Tyne, "Open Water Test Series with Modern Propeller Forms: Part 3, Two-Bladed and Five-Bladed Propellers; Extension of the Three and Four-Bladed Series," L. Troost, 6.15 p.m.

Sheffield Society of Engineers and Metallurgists

Mon., Dec. 18th.—Royal Victoria Station Hotel, Sheffield, Annual General Meeting, "Some Technical and Economic Aspects of Industrial Research," D. A. Oliver, 6.15 p.m.

Society of Chemical Industry

To-day, Dec. 15th.—Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1, "Aggregate Packing in Road Carpets," J. F. T. Blott, 6 p.m.

Society of Engineers

To-day, Dec. 15th.—17, Victoria Street, London, S.W.1, papers by E. B. Pratt and E. G. Purkis, 6.30 p.m.

Stephenson Locomotive Society

Sat., Dec. 16th.—N.W. CENTRE: Geographical Society, Deansgate, Manchester, "West Cumberland Byways," McGowan Graham, 6.15 p.m.——Central Station, Liverpool, "Symphony No. 5 Unfinished (a Ubiquitous Locomotive Class)," W. H. Whitworth, 7 p.m.

West of Scotland Iron and Steel Institute

To-day, Dec. 15th.—39, Elmbank Crescent, Glasgow, "Tube Manufacture," J. W. Jenkin, 6.45 p.m.

Launches and Trial Trips

BINTA, motor tanker; built by Harland and Wolff, Ltd., for Mr. Per Gjerding, Bergen; length between perpendiculars 460ft, breadth moulded 59ft, depth moulded 34ft 10in, deadweight 12,000 tons; Harland-Burmeister and Wain diesel engine, six cylinders, 740mm diameter by 1500mm stroke. Launch, September 28th.

BOLETTE, motor tanker; built by Harland and Wolff, Ltd., for Fred Olsen and Co., Oslo; length between perpendiculars 580ft, breadth moulded 78ft, depth moulded 42ft 6in, deadweight 24,000 tons; Harland-Burmeister and Wain diesel engine, seven cylinders, 750mm diameter by 2000mm combined stroke. Launch, September 28th.

BRATSBERG, motor tanker; built by Harland and Wolff, Ltd., for Aktieselskabet, Borgestad; length b.p. 460ft, breadth moulded 59ft, depth moulded 34ft 10in, draught 27ft 6in; 12,000 tons deadweight; Harland-Burmeister and Wain single-acting four-stroke diesel engine, six cylinders, 740mm diameter by 1500mm stroke, two single-ended multitubular boilers, steam-driven auxiliaries. Trial, October 5th.

KAWATIRI, cargo ship; built by Henry Robb Ltd., for the Union Steamship Company of New Zealand, Ltd.; length 290ft, breadth 43ft, depth 19ft 6in, 3030 tons deadweight; Two British Polar diesel engines, five cylinders, 1450 b.h.p., 11 knots. Trial, October 10th.

ATHEL DUCHESS, motor tanker; built by R. and W. Hawthorn, Leslie and Co., Ltd., for the Athel Line; length 494ft, breadth moulded 63ft 3½in, depth moulded 34ft 7in, 12,500 tons deadweight; Hawthorn-Doxford oil engine, four cylinders, 670mm diameter by 2320mm combined stroke, 4450 b.h.p. at 112 r.p.m. Launch, October 11th.

PUNTA MEDANOS, fleet oiler; built by Swan, Hunter and Wigham Richardson, Ltd., for the Argentine Navy; length b.p. 470ft, breadth moulded 62ft, depth moulded 35ft, draught 25ft 10in, 8500 tons deadweight; two sets of Wallsend Slipway double-reduction geared turbines, taking high-pressure superheated steam from two Babcock and Wilcox boilers, one auxiliary boiler; speed 19 knots. Trial, October 10th.

BRITISH SPORTSMAN, motor tanker; built by Swan, Hunter and Wigham Richardson, Ltd., for the British Tanker Company, Ltd.; length 547ft, breadth moulded 69ft 6in, depth moulded 37ft 6in, 15,875 tons deadweight; Wallsend-Doxford oil engine, six cylinders, 670mm diameter by 2320mm combined stroke, 6400 b.h.p. at 115 r.p.m. Launch, October 12th.

SATURNUS, motor tanker; built by the Furness Shipbuilding Company, Ltd., for Rederiaktiebolaget Saturnus, Sweden; length b.p. 496ft, breadth moulded 67ft 6in, depth moulded 36ft 5in, 16,300 tons deadweight; North Eastern Marine-Doxford oil engine, five cylinders, 670mm diameter by 2320mm combined stroke, 5500 b.h.p. at 114 r.p.m. Launch, October 12th.

SWIFT, cargo ship; built by Henry Robb, Ltd., for the General Steam Navigation Company, Ltd.; length b.p. 196ft, breadth moulded 33ft 6in, depth moulded 20ft 4¼in, 740 tons deadweight; British Polar diesel engine, seven cylinders, 340mm diameter by 570mm stroke, 1120 b.h.p. at 250 r.p.m., 12 knots. Trial, October 18th.

SLOVENIJA, cargo and passenger liner; built by the Netherlands Dock and Shipbuilding Company for the Jugoslavenska Linijska Plovidba; length b.p. 435ft, breadth moulded 59ft, depth moulded 39ft 5½in, 9000 tons deadweight; Stork diesel engine, six cylinders, 6250 b.h.p. Launch, October 21st.

CITY OF SINGAPORE, cargo liner; built by Alexander Stephen and Sons, Ltd., for the Ellerman Lines, Ltd.; length 450ft, breadth 61ft 6in, depth 32ft 9in, 10,750 tons deadweight; single set of Parsons turbines, taking superheated steam from two Babcock and Wilcox boilers, 5500 s.h.p. Launch, October 26th.

SANTHIA, passenger and cargo liner; built by Barclay Curle and Co., Ltd., for the British India Steam Navigation Company, Ltd.; length 479ft 3in, breadth 62ft 6in; depth 35ft, 8600 tons deadweight, 9050 tons gross; two sets of Barclay Curle-Doxford opposed piston, two-cycle oil engines, four cylinders, 560mm diameter by 2160mm combined stroke, two multitubular cylindrical boilers, speed 15 knots. Trial, November 3rd.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London, S.W.1.

INDUSTRIAL PERFORATED PLATES

No. 1669: 1950. This standard on industrial perforated plates replaces that part of B.S. 481, woven wire and perforated plate sieves and screens for industrial purposes, which was originally issued in 1933. It covers industrial perforated plate having round and square apertures with the sizes and arrangements which are most commonly used, and tolerances on aperture size and pitch of apertures have been introduced.

No attempt has been made to standardise other shapes of aperture such as slots. The main reason for this omission is that a very wide range of these different shapes of aperture is involved.

The standard, in addition, contains three tables giving aperture sizes and three pitch arrangements for industrial perforated plate with apertures from ¼in to 3in.

Price 2s., post free.

ROYAL SOCIETY MEDALLISTS.—His Majesty The King has been graciously pleased to approve a recommendation made by the Council of the Royal Society for the award of a Royal Medal for the current year to Sir Edward Appleton, G.B.E., K.C.B., F.R.S., for his work on the transmission of electromagnetic waves round the earth and for his investigations of the ionic state of the upper atmosphere. Among the awards made by the President and the Council of the Royal Society are the Copley Medal to Sir James Chadwick, F.R.S., for his outstanding work in nuclear physics and in the development of atomic energy, especially for his discovery of the neutron; the Rumford Medal to Air Commodore Sir Frank Whittle, K.B.E., C.B., F.R.S., for his pioneering contributions to the jet propulsion of aircraft; the Davy Medal to Sir John Simonsen, F.R.S., for his distinguished researches on the constitution of natural products, especially the plant hydrocarbons and their derivatives; the Darwin Medal to Professor F. E. Fritsch, F.R.S., for his distinguished contributions to the study of algology, and the Hughes Medal to Professor M. Born, F.R.S., for his contributions to theoretical physics in general and to the development of quantum mechanics in particular.